Aviation Week

Including Space Technology

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September 29, 1958

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USAF Testing Heat Stable Oils

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AVIATION CALENDAR

Oct 6-7—National Symposium on Extended Range and Space Transmission, sponsored by Institute of Radio Engineers and George Washington University, Lisner Auditorium, Washington, D C

Oct. 6-10—Second Annual Conference, Society of Photographic Scientists & Engineers, Hotel Manger, Rochester, N Y

Oct 7-8—1958 Joint Meeting Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Chateau Laurier, Ottawa, Canada

Oct 7-9—Third Symposium on Hypervelocity, Chicago, Ill. Jointly sponsored by USAF Office of Scientific Research, U S Army, and U S Navy, with Armour Research Foundation

Oct 8-10—14th Annual Aviation Spark Plug and Ignition Conference, Champion Spark Plug Co., Secor Hotel, Toledo

Oct 9-10—Ninth Annual National Noise Abatement Symposium sponsored by Armour Research Foundation, Hotel Sherman, Chicago, Ill

Oct 12-18—Sixth Annual USAF Weapons Competition, two tactical fighter phases, Tactical Air Command, Nellis AFB, Nev

Oct 13-15—ASME-ASLE Joint Lubrication Conference, Statler Hotel, Los Angeles, Calif

Oct 13-15—14th Annual National Electronics Conference, Hotel Sherman, Chicago, Ill

Oct 15-17—Twelfth Annual Meeting Southeastern Airport Managers' Assn, The Palm Beach Terrace, Palm Beach

Oct. 20-21—Fourth National Aero-Com Symposium sponsored by Institute of Radio Engineers, Hotel Utica, Utica, N Y

Oct. 20-22—1958 Annual Meeting Assn of the United States Army, Sheraton Park Hotel, Washington, D C

(Continued on page 6)

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AVIATION CALENDAR

(Continued from page 5)

Oct 20-22—National Safety Congress and Exposition, Aeronautical Industries Section, National Safety Council, Conrad Hilton Hotel, Chicago, Ill.

Oct 20-30—Sixth Annual USAF Weapons Competition, interceptor phase, Air Defense Command, Tyndall AFB, Fla.

Oct. 22-24—Fifth National Vacuum Symposium, San Francis Drake Hotel, San Francisco, Calif.

Oct 22-24—Meeting of Aviation Medicine, sponsored by University of California, Miramar Hotel, Santa Monica, Calif. For details: Thomas H. Sternberg, M.D., Assistant Dean for Postgraduate Medical Education, UCLA Medical Center, Los Angeles 24, Calif.

Oct 23—Jet Transportation Day, sponsored by Chicago Assn. of Commerce and Industry, Sherman Hotel, Chicago, Ill.

Oct 23-25—1958 National Simulation Conference, sponsored by Institute of Radio Engineers, Professional Group on Electronic Computers, Statler-Hilton Hotel, Dallas, Tex.

Oct 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.

Oct 27-28—East Coast Conference on Aeronautical & Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct 27-31—National Metal Exposition and Congress, Cleveland Public Auditorium, Cleveland, Ohio.

Oct. 29-31—Air Traffic Control Assn., Annual Business and Council Meeting, Marriott Motor Hotel, Washington, D.C.

Oct 30-31—1958 Electron Devices Meeting, sponsored by Institute of Radio Engineers, Shoreham Hotel, Washington, D.C.

Nov. 6-7—Quarterly Regional Meeting, Assn. of Local & Territorial Airlines, Honolulu, Hawaii.

Nov. 6-7—Fifth Annual Meeting, Institute of Radio Engineers Professional Group on Nuclear Science, Villa Hotel, San Mateo, Calif.

Nov. 6-7—National Specialist Meeting on Dynamics and Aeroelasticity, sponsored by Institute of the Aeronautical Sciences, Texas Section, Texas Hotel, Ft. Worth.

Nov. 10-12—International Conference, Physics and Medicine of the Atmosphere and Space, sponsored by the School of Aviation Medicine, San Antonio, Tex.

Nov. 10-13—11th Annual International Air Safety Seminar, Flight Safety Foundation, in cooperation with Airways Modernization Board's National Aviation Facilities Experimental Center, Atlantic City, N.J.

Nov. 10-21—12th Air Transportation Institute of the American University, Washington, D.C.

Nov. 12-14—1958 Annual Meeting, Society for Experimental Stress Analysis, Hotel Sheraton Ten Eyck, Albany, N.Y.

Nov. 17-18—Sixth Annual Aircraft and Missile Division Conference, American Society for Quality Control, Biltmore Hotel, Dayton, Ohio.

Nov. 17-21—13th Annual Meeting and Aeronautical Exposition, American Rocket Society, Hotel Statler, New York, N.Y.

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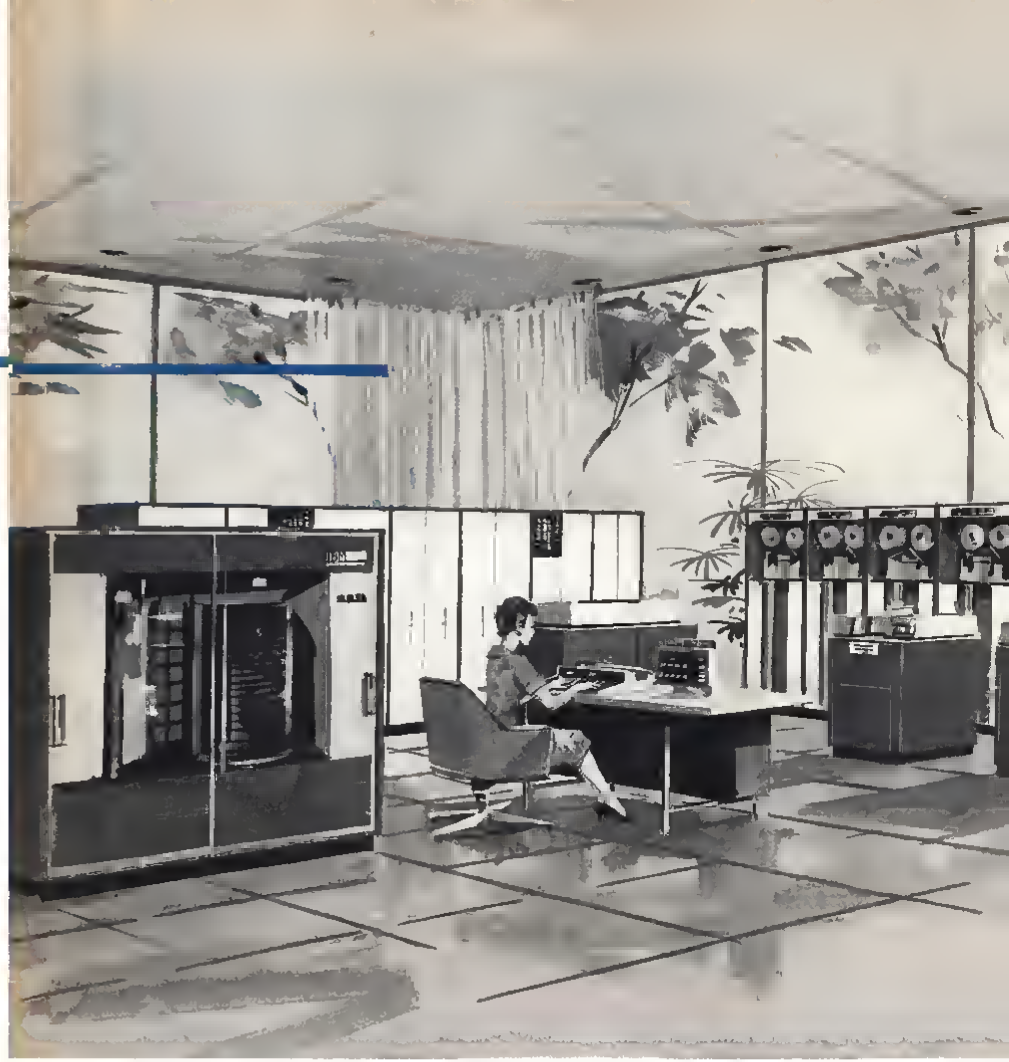

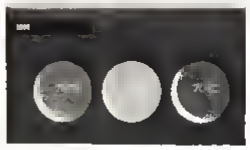

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EQUIPMENT

EDITORIAL

COVER: First prototype of Blackburn NA 39 naval strike fighter made aerial passes over Farnborough show but did not land and was not on static display. Large NA 39 model was mounted high off ground, apparently to forestall any attempts to take detailed measurements. Aircraft is designed for high speed at low levels. For other NA.39 flight views turn to page 49.

PICTURE CREDITS

Cover—Russell Melcher; 19—Wide World; 20—North American Aviation, Inc.; 21—Pratt & Whitney Aircraft; 22—UPI; 23—Hughes Aircraft Co.; 24 (top)—Dunn-Maur; 24, 25—USAF; 26 (top)—Goodyear Aircraft Corp.; 32, 55—Minneapolis-Honeywell; 39—U. S. Navy; 43—Richard D. Rendell; 49—Russell Melcher; 51—WADC; 55—Convair; 60—de Havilland; 61 (top left)—(and bottom)—Erwin J. Bulban; 61 (top right)—de Havilland; 67—Erwin J. Bulban; 73—Charles E. Brown; 81—Cessna.

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EDITORIAL

Civil Space Role Defined

(Dr Hugh L Dryden, deputy administrator of the National Aeronautics and Space Administration and for 11 years head of its predecessor, the National Advisory Committee for Aeronautics, last week emphasized the need for long-range, long-term financial support if the U.S space effort is to succeed, the basic differences between NACA and NASA, and NASA's increased reliance upon the aviation industry Because of its interest and importance, AVIATION WEEK is reproducing below significant portions of Dr Dryden's speech at the Air Force Assn convention in Dallas)

Now, I must add that I am aware—I could say, painfully aware—of the belief stated in some quarters that unless there is a definite military potential to our work in space technology and space exploration, adequate financial support will not be forthcoming for long from future national administrations and future congresses I am aware of the dangers of predicting what will happen in the future, but on the basis of what we already know, I think that in a relatively short time the economic payoffs of our civilian space effort will have been so large as to make the entire space effort fully self-financing

In my personal opinion, it is factually incorrect to state that the only proper justification for supporting work in space is military Plainly, it is a perversion of the facts to suggest that all non-military space activity should be considered mere "fun in space "

Our planning for space must be with the awareness that sustained and intensive efforts will be required for many years to come

It would be tragic indeed if our national space programs were to be subjected to the uncertainties of a "blow hot, blow cold" kind of financing This possibility, I believe, is most fortunately remote because of an awareness of how grave the urgency is for us to become and remain leaders in the exploration of space

Now, I should like to discuss briefly the National Advisory Committee for Aeronautics vis-a-vis the National Aeronautics and Space Administration For 11 years, I was privileged to head the NACA staff The work of the 8,000 scientists, engineers and other employes seeking solutions to the problems of flight represented one of the best returns ever made on the taxpayers' dollars

I am proud, and I believe my feeling is shared by all others of the organization, that the NACA was the choice of all other government agencies to serve as the nucleus of the NASA

But make no mistake, the NASA is a new agency It will be different from NACA in many ways The vital functions of NACA, research into the problems of flight, will be continued and perhaps even intensified, but this activity will be only one part of NASA's programs NASA will have to administer substantial programs of research, development and procurement, on a contract basis It will be spending large amounts of money, outside the agency, by contracts with scientific and educational institutions, and with industry . .

NASA will have to broaden and extend the excellent, teamwork relationships that NACA enjoyed over the years with the military services and with the airplane missile-space industry It will be using facilities of the armed forces It will be expanding its own facilities at Wallops Island on the Virginia coast to permit launching satellites up to, say, 100-lb size It will be operating satellite tracking stations around the world It will be collecting great masses of scientific data, and reducing them to useful form

This week (T Keith) Glennan (NASA administrator) addressed a message to all NACA employes Referring to the Sept 30 takeover date, he conceded that one way to describe what will happen would be to quote from the legalistic language of the Space Act: "The NACA shall cease to exist (and) all functions, powers, duties and obligations and all real and personal property, personnel (other than members of the Committee), funds and records of that organization" shall be transferred to NASA

Then he continued, 'My preference is to state it in a quite different way I like to say, and I believe I am being very realistic and very accurate when I do that what will happen Sept 30 is a sign of metamorphosis an indication of the changes that will occur as we grow to where we can do the bigger job that is ahead "

What does Dr Glennan think about private industry and the role it must play in our national space program? I haven't talked with him about this, but I have read a major address of his, titled, "Industry's Next Step in Atomic Energy," made just after he had completed two years as a member of the Atomic Energy Commission

"Among the things I brought with me," he said of his going to the AEC "was a strong belief in the essential rightness of the American system of free competitive enterprise and a strong conviction that it could be made to work in the development of atomic energy "

Later in his speech, he said, "I believe you will see why the government cannot be expected to carry the ball alone on this matter of industrial participation The commission's main job is to guarantee the common defense and security It is a big job, and a time-consuming one, and if anyone thinks that the commission can take time off from its defense work to look around for something to hand to industry on a solid plutonium platter, he is not being very realistic Let there be no mistake about it, industry will get only those things that it can prove it really wants, it can really handle and it really should have in the public interest "

As I said, I haven't talked to him about his views about the part of private industry in the space programs, but if I were a wagering man, I'd bet a penny or two that if you substituted space for atomic energy in what I've just quoted, you'd be very close to knowing what Keith Glennan thinks on the subject

WHO'S WHERE

In the Front Office

Dr. Fritz-Aurel Goergen, board chairman, Henschel Werke GmbH, Kassel, West Germany.

Daniel J. Haughton and **Dudley E. Browne**, directors, Lockheed Aircraft Corp., Burbank, Calif. Mr. Haughton is executive vice president of the company, and Mr. Browne vice president-finance and controller.

Rahland C. Zinn, a director and base manager of Lockheed Aircraft Service International, Inc., Jamaica, N. Y.

E. M. Armstrong, vice president-customer relations, Coleman Engineering Company, Inc., Torrance, Calif.

D. R. Gero, vice president and general sales manager, G. M. Giannini & Co., Inc., Pasadena, Calif.

Ira Kamen, vice president, General Bronze Corp., Garden City, N. Y.

John M. Stuber, vice president and general manager, Minnesota Airmotive, Inc., Minneapolis, Minn.

A. V. Zukas, vice president, Parker Aircraft Co., Los Angeles, Calif.

Frederick W. Hesse, Jr., vice president, administration and finance, Space Technology Laboratories, a division of Ramo Wooldridge Corp., Los Angeles, Calif.

Arthur W. Miller, vice president and general manager, Ultradyne, Inc., Albuquerque, N. M.

Warren R. Smith, general manager of the newly established Applied Science Division, Fairchild Engine and Airplane Corp., Alexandria, Va.

Everard M. Lester, general manager, Engine Division of Fairchild Engine and Airplane Corp., Deer Park, N. Y.

Leete P. Doty, assistant general manager, Sikorsky Aircraft Division, United Aircraft Corp., Stratford, Conn.

Changes

Donald H. Prest, associate director of research, Eitel McCullough, Inc., San Carlos, Calif.

Sidney C. Argyle, head, newly established Optics Department, Avionics Division, Aerojet-General Corp., Azusa, Calif.

Donald J. Gimpel, director of research, and **Ellison F. Miller**, chief development engineer, Armour Corp., Los Angeles, Calif.

Pratt & Whitney Aircraft, a division of United Aircraft Corp., East Hartford, Conn., has appointed the following assistant chief engineers: Davis G. Phinney, for production Connecticut operations; and Donald D. Pascal, for advanced projects, at the company's Florida Research and Development Center.

Thomas P. Higgins, head, research and development activities, Lockheed's Missile Systems Division, Van Nuys, Calif.

James B. Ford, manager, system publicity, Capital Airlines, Inc.

Harrison F. Edwards, technical operations manager, and **Harlan C. Pringle**, field operations manager, Contracts and Service Division, Simmonds Aerocessories, Inc., Tarrytown, N. Y.

INDUSTRY OBSERVER

► Program to develop airborne ballistic missile detection aircraft equipped with infrared surveillance equipment which could nearly double the warning time now expected from ground-based Ballistic Missile Early Warning System (BMEWS) is bogged down for lack of funds and over question of whether program should be sponsored by Air Force or Advanced Research Projects Agency. Infrared-equipped jet aircraft flying above 40,000 ft. reportedly could provide additional 10 min. warning time as well as pinpoint ICBM locations for anti-ICBM missiles (AW May 26, p. 23).

► Development work on a General Electric combination turbojet-ramjet powerplant is an extension of the company's basic J93 design planned for North American Aviation's B-70 and F-108 Mach 3 aircraft. Known as the "Q" version of the J93 and targeted for a Mach 5-6 range, the engine's general scheme may have a Mach 8 limitation. The project is being supported by Air Force although no specific application has yet been projected for the powerplant.

► Pratt & Whitney Aircraft also is working on a combination turbojet-ramjet. Company's J58, which could be refined to serve as the turbojet portion of this combination, would be capable of developing on its own about 20,000 lb. thrust without afterburner and about 30,000 lb. thrust with afterburner. Company's J91 turbojet development for the Convair WS-125A nuclear aircraft probably will be capable of developing 40,000 lb. thrust with afterburner.

► Proposals for supersonic military transport study contracts have been made by seven airframe companies to Air Research and Development Command. Companies include Convair, Boeing, Lockheed, Douglas and North American Aviation. North American's proposal covers a military transport version of the Mach 3 B-70. If the military transport application is accepted, the concept may be carried further and include development of a commercial transport configuration for Mach 3 and higher service. In this way, three different aircraft could develop from the basic weapon system program, with considerable redesign to meet military and commercial requirements.

► Navy has won its battle with Defense Department fiscal planners over the fate of the Eagle long-range air-to-air missile. Fiscal officials, faced with a tight budget, had asked Navy to adopt Air Force's GAR-9 designed for the F-108 and abandon the Eagle for economy reasons (AW Sept. 15, p. 23). Navy, however, contended that the Hughes missile would not fit the Eagle's intended mission. Eagle is scheduled to be carried by the Grumman A2F attack plane now under development.

► Space Technology Laboratories, scheduled to split from Ramo Wooldridge Corp. and become a separate corporation, is making a series of proposals to Air Force in connection with the Man in Space Soonest project. Proposals cover bids for both the systems engineering and technical direction of the MISS program.

► North American Aviation is considering formation of a scientific advisory group to assist top management in long-range space technology planning. Group would consist of outside consultants and company scientists.

► First static test firings of the Titan intercontinental ballistic missile engines at Cape Canaveral, Fla., are due within a few weeks. Flight test of the first Titan is expected by late autumn.

► Ship motion simulator for Polaris fleet ballistic missile has been completed by Loewy-Hydropress Division of Baldwin-Lima-Hamilton Corp. at Cape Canaveral, Fla., and accepted by Navy.

► Air Force has asked Convair and Lockheed to submit proposals for nuclear-powered aircraft designs by end of October in the hope of obtaining White House approval to proceed with design and fabrication of experimental aircraft.

Washington Roundup

'Direct Appraach' Need

While President Eisenhower has been following a "second-hand" approach in the handling of scientific problems, Russia's Nikita Khrushchev apparently has adopted the "direct" approach advocated by many U.S. scientists as the only real way heads of state can acquire an understanding of the potential of modern science.

In the "second-hand" method, the President's principal scientific contact, Dr. James R. Killian, briefs the Chief Executive after first distilling the primary facts concerning the complete range of scientific effort. The President actually has little contact with scientists or with scientific topics and problems other than through Dr. Killian, although this contact was broadened last week when the President first met with the National Aeronautics and Space Council, which he chairmans under the law.

Khrushchev, according to Moscow reports, is broadening his direct contacts with scientists and has held lengthy meetings with them. During the discussions, the scientists go over their objectives and problems and Khrushchev continually emphasizes the key role they are playing in the Soviet effort to gain a clear military and economic superiority over the U.S.

The first of these informal conversations, held early this year with members of the Presidium of the Academy of Sciences of the USSR, lasted approximately two hours. This was the first time that the head of the Russian state or a high figure in the Communist Party had met with Soviet scientists on such a basis.

A. N. Nesmeyanov, president of the Academy, in a report in the Academy's journal, indicated that the first meeting with Khrushchev was very successful. The meetings have continued at fairly close intervals.

Nesmeyanov has reported that, since the first meeting, Khrushchev has given the Academy a virtual carte blanche for its research. Any project that the Presidium of the Academy regards as necessary will be funded.

Pentagon 'Finalizatian'

Annual Pentagon exercise known as "finalization" of the next fiscal year's budget is under way, accompanied by two other exercises that have become common since the "constant budget level" concept was born.

- **Rumors that everything from** major missile projects to turbine blades will be missing from next year's programs.
- **Echoing by defense** leaders of the theme sounded by Defense Secretary Neil McElroy several weeks ago that military needs must, after all, be weighed against dollars available and that we can all get along with less. This is known in the Pentagon as the "manly" or "stiff upper lip" approach to budgetary affairs. Most recent examples:
- **"Our country's military strength** must be balanced with our economic strength. Neither must be subordinated to the other. If we neglect our military strength we may well find ourselves in the position where our economic strength is powerless to ensure our continued freedom. On the other hand, irresponsible spending for military hardware could result in our losing, without ever firing a shot, the very things we now would fight for."—Gen. Nathan Twining, chairman, Joint Chiefs of Staff, before Defense Orientation Conference Assn.
- **"Technical developments** and changes in strategic concepts frequently cause us to close existing installations or shift our procurement programs. We try to do this with as little economic disruption as possible to the civilian economy, but our citizens must always remember that the Air Force's business is defense, not economic support"—Dudley C. Sharp, assistant secretary of the Air Force for Materiel, at Air Force Assn. convention.

Flarida Delay

Plans of three airlines to inaugurate service on their newly awarded routes to Florida in the early part of December in time to start schedules for the Miami winter season may undergo a forced revision as the result of a Civil Aeronautics Board failure to issue a decision in the case. Route awards were announced in a "press release" by the Board last spring (AW April 7, p. 41) but no decision delineating the operating rights of the carriers on the three routes has been issued.

Possibility was strong late last week that the long-awaited decision would be issued "within a few days," but such reports have been persistently wrong in recent weeks. If a decision is not out by Oct. 1, these three airlines will be required to set back the Dec. 1 target date for the new service since the Board order will provide that routes cannot be implemented until 60 days after the date of the order.

Space Law

Pressure is mounting for action in developing a legal blueprint designed to insure orderly and peaceful use of outer space. One of the latest to point out the necessity of such action is Gilbert C. Jacobus, George Washington University research professor. In a speech at the Federal Bar Assn. annual convention here last week, Jacobus warned that space law must keep step with scientific developments to prevent anarchy in the use of outer space. He pointed out that there has been broad and intense effort to resolve engineering and other problems of space flight but that comparatively little attention has been paid to international relations.

Airlift Debate

Air Force Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, has answered critics of the recent Lebanese airlift by saying it was not done too slowly or with too few aircraft but was planned and executed as "peaceable introduction of troops in a deliberate manner."

"With regard to the airlift," Gen. Twining told a Defense Orientation Conference Assn. meeting, that "the U.S. Air Forces in Europe have a normal complement of 60 four-engine aircraft and 48 two-engine Fairchild C-119s. An additional 36 Douglas C-124s were provided by MATS to assist in this operation.

"These planes took care of the requirements of the operation. Had there been additional requirements, there were immediately available and operational 332 four-engine planes of MATS and the Tactical Air Command, without touching the planes used for necessary continuing air traffic for the Air Materiel Command, in essential support of the Strategic Air Command, or in use by the Navy.

"In addition, 300 four-engine aircraft were available on short notice from commercial resources. In summary, over 600 four-engine aircraft could have been made available almost immediately if they had been required."

—Washington staff

Military May Accelerate Lunar Base Plan

Spurred by Soviet efforts toward lunar landings, U. S. leaders may push similar research plans.

Washington—Top U S military planners, alerted to Soviet efforts to prepare for manned lunar landings leading to the establishment of a moon base, are considering steps to push similar research in this country to head off what might be a disastrous repetition of the "get-there-first" pattern by the Russians with its series of Sputnik earth satellites.

Even though realization of operational moon bases are years in the future, the Soviet's general philosophy is pointed toward work on a "very soft landing" on the lunar surface, put out a tank-type vehicle to cope with dust or volcanic rock cover in the exploration for the best successive landing pattern, set areas and permanent base location.

Exploration information would be telemetered back to earth before a lunar takeoff for the return trip to earth with material samples, leaving the exploration tank behind.

Homing beacon also would be left at a selected, feasible landing site on the moon to assist manned lunar follow-up vehicles to make pinpoint landings on the moon to ensure safety and to save time and effort in base establishment.

Information is that Soviet planners have taken a very simple approach based upon the premise that the key factor in the projected establishment of a lunar base is concentration upon analysis leading to the development of "end-item" equipment since most or at least much of the basic research and development will be accomplished in the normal course of development associated with intercontinental ballistic missiles, earth and lunar satellites and other "close-in" exploratory space vehicles.

Other evidence that Soviet planners actively are headed along the technical road to the moon is the existence of a new, highly scientific Soviet movie film revealing detailed projections for manned lunar exploration.

Large, precise working models are used in the film. Scenes show:

- Probable rocket configuration.
- Landing procedure, including retrorockets for killing approach speed.
- Final stage's extensible legs with provisions for adjusting the length automatically to compensate for possible uneven terrain in achieving an even keel setdown.
- Huge tank, which is put out from the final stage, then reached and propelled over the lunar landscape.
- Crewmen, who leave tank for brief periods to make measurements with scientific equipment, collect material samples for subsequent analysis.

One of the preliminary undertones in Soviet progress toward a general lunar capability is the existence of a 750,000 lb. thrust operational military rocket booster developed for both military and satellite applications. Details of their engine are not even widely disseminated among Soviet scientists except those working on the project so close are the Russians in keeping this technical development quiet.

By comparison, North American Aviation's Rocketdyne Division has begun work on 1.5 million lb. thrust boosters for the Air Force and Army's Ballistic Missile Agency. The ABMA booster will combine engines similar to that in the Jupiter but with various modifications. Eight of these units probably will be required and possibly 10 to compensate for the loss in efficiency resulting from combining the engines. This unit may be ready by next summer if the project gets proper emphasis. Air Force unit would be a huge single barrel configuration.

Renewed Interest

Renewed interest by top U S planners in laying the initial foundation for lunar landings and bases possibly within the next 10 years brings into sharp focus the spasmodic but intense controversy between prominent authorities in both scientific and military circles concerning the value of the moon as a military base.

One of the most vocal critics in scientific circles of value of military launch sites on the moon has been Dr. Lee A. DuBridge, president of the California Institute of Technology, who has warned against "wild programs of Buck Rogers stunts and insane pseudo-military expeditions" (AW March 31, p. 22).

On the other hand, scientific and military proponents who see the moon as a possible military base contend that no one at this time can definitely rule out the feasibility of its potential. They contend that the possibilities of space utilization are shrouded because of the infancy of exploration in this field and that plans must be made now, for example for possible use of the moon for military purposes to insure that the U S effort will be ahead of, or equal to, Soviet capabilities.

Proponents of a lunar base admit that adverse criticism of the moon base philosophy from some scientists has influenced thinking in high official circles. Other factors, they say, which have caused hesitancy in putting support behind moon base preparational studies, have been the desire to get the United Nations behind a "no claim" approach to eliminate possible international controversies in space exploration, the current emphasis upon ICBM and IRBM programs and the recent uncertainty preceding the creation of the new National Aeronautics and Space Administration.

Outspoken proponent of moon base utility is Brig. Gen. Homer A. Boushey, Air Force director of advanced technology. Gen. Boushey feels that the moon provides a retaliation base of unequalled advantage (AW Feb. 10, p. 27). "If we had a base on the moon," Gen. Boushey has said, "either the Soviets must launch an overwhelming nuclear attack towards the moon from Russia two to two-and-one-half days prior to attacking the continental U S. (and such launchings could not escape detection) or Russia could attack the continental U S. first, only and inevitably to receive from the moon some 48 hours later sure and massive destruction."

Gen. Boushey recently declared: "... I for one would not like the Russians to prove to us that the moon is a useful military site, for our future may be determined by the answer. Shall we or the Soviets find that answer?"

Final disposition of where support will be channeled in this controversy has not been resolved, but top U S planners in the overall defense and space technology picture are receptive to proposals for studies to tackle some of the initial problems envisioned in the long-range approach to manned lunar landings and bases. Sizable initial financial support for this work may not be too difficult to get, observers close to the picture believe.

Swedish Bloodhound

London—Sweden has placed an order for the Bristol Ferranti Bloodhound guided weapon system. It is Britain's first guided missile sale to a foreign country.

Atlas ICBM Explodes

Thirteenth USAF-Convair Atlas intercontinental missile, fired in an attempt to reach its full 5,500 mi. range, exploded some 83 to 85 sec. after launching from Cape Canaveral, Fla. Missile's nose cone is sharper than that on 'A' series missile.

York Outlines Satellite Plans

Washington—U S satellites weighing from 500 lb. to 1.5 tons "should be flying sometime in 1959," Dr. Herbert York, chief scientist of Advanced Research Projects Agency, told the Defense Orientation Conference Assn. here.

The satellites will be launched by intermediate range and intercontinental range missiles with second stages added. York said these vehicle-plus-weight combinations are planned:

- Satellites of "500, 1,000 or perhaps even 1,500 lb." launched by IRBMs with upper stages now being developed.
- Satellites of "1.5 tons or maybe even two tons" launched by fCBMs plus upper stages.
- Satellites of "three or four tons" launched by ICBMs plus upper stages plus high energy fuels.

"There has been the impression that in order to get big payloads like the Russians have put up, 3,000 lb., it is necessary to do so with something that is somehow either much more exotic than we know how to do or that it requires enormously bigger rocket boosters than we have," York said.

"That isn't so. The boosters of our ICBM type rockets will be capable of putting up 3,000 lb. when additional conventional rockets are added as upper stages."

York also suggested two possible solutions to "this problem" of the radiation in space discovered by Explorer satellites:

- "First of all, (it) does appear to consist of 50 million volt protons, in that case it should be possible to shield a person with a few tenths of a ton of shielding. This is not an unreasonable amount of material to launch into space.
- "The other possibility is to go out through the poles, because although we are not absolutely sure, it does appear there is none of this over either the north pole or south pole. It therefore looks as though the earth space port that they like to write about in the comics and science fiction is more likely to be at the north pole rather than some convenient place like New Mexico, or wherever it is usually put."

Perhaps the most important point of the radiation discovery, York said, is the fact that it was "completely unexpected." Practical applications of space travel also are "likely to be things that we haven't thought of at all, rather than things which we are now definitely planning on doing," he said.

- ARPA so far has contracted for research and development and studies only through the services.
- Well over 90% of ARPA's work is in space and ballistic missile defense programs, with missile defense employing the most people but not the most funds.
- Remainder of the work is weapons analysis studies, development of chemicals for solid propellants and classified projects.
- Each of the services is working on ballistic missile defense systems and anti-missile missiles.
- Satellite orbiting 22,000 mi. from earth and transmitting with 10 watts of power on 100 megacycles and using a 250 kilocycle bandwidth could be received on a home FM radio set.
- Using 100 watts of power plus special antennas on the satellite, it should be possible to broadcast commercial television to household equipment over half the earth.
- Using the power and frequency of the Bell System's transcontinental microwave system and special antennas, it should be possible to have some 10,000 voice conversations going on simultaneously across the oceans, using only one satellite.

Test Shot Eddy

Last nuclear test series before the Oct. 31 imposition of President Eisenhower's ban on nuclear weapons tests for another year was begun here with test shot Eddy, the explosion of a small nuclear tactical warhead with a yield of a fraction of a kiloton. Eddy was suspended from a captive balloon at an altitude of 500 ft. Diameter of the fireball was estimated at 2,000 ft. or less.

A smaller device will be fired later in the series. It will be located upon a 50 ft. wooden tower to minimize production of radioactive materials. Fireball is not expected to touch the ground.

Sabreliner UTX Uses J85 Engines On Initial Flight

North American Sabreliner UTX twin turbojet utility transport is first new aircraft to fly with General Electric J85 lightweight low fuel consumption engines. Aircraft made its first flight this month at Palmdale, Calif. (AW Sept. 22, p. 37). Test pilot J. O. Roberts and copilot Gage Mace took the Sabreliner to 35,000 ft. and reached speeds of about 400 mph. First takeoff roll was 3,000 ft. at maximum gross weight of 15,300 lb. Engineers say normal design takeoff roll is 2,500 ft. Aircraft has leading edge slats extended and gear down in top photo but main wing flaps are not extended as in a landing configuration. Bottom photo shows aft placement of J85 engines. Sabreliner carries 4-8 passengers at speeds up to 575 mph. Cabin is pressurized at 8,000 ft. The aircraft is company funded and is available for purchase by the military on an off-the-shelf basis. Fuselage is 43 ft. long with 42 ft. wing span. Height is 16 ft. Extra-wide pilot's windshield has been provided for maximum visibility.

Business Flying Market Making Recovery

By Erwin J. Bulban

Philadelphia—Feeling that business flying market has reached the end of a "leveling off" period brought about by the nationwide business recession and is now making a firm recovery pervaded the atmosphere here at National Business Aircraft Assn.'s 11th annual meeting and forum.

Indications are that softness encountered by varied segments of the industry was felt most by firms doing modifications of airframes, and then by equipment manufacturers—particularly avionics suppliers—with airframe builders feeling the leveling off the least.

Contributing to declines not only was the general practice by many business aircraft users of paring operating budgets and putting off planned purchases until business revived, but also the knowledge that considerable new equipment had passed the engineering and test stages and would be ready late this year or early in 1959.

Avionics Firms Hit

Avionics manufacturers were particularly affected by this tendency of customers to hold off until new items became available. Business aircraft users were encouraged in this thinking by the tone of the NBAA meeting in Denver last year, where much new equipment was shown in mockup and also where firms which previously had been heavily committed to military and airline business indicated that they were coming into the executive aircraft market to diversify their sales effort.

Collins Radio Co. personnel, for example, noted that commercial sales this year probably will come to some $111 million compared with approximately $120 million in Fiscal 1957 but say that Fiscal 1959 should see the sales build up to $150 million. Bendix Radio Division reported that its commercial market showed a slippage of some 25 to 30% earlier this year, but that business shows a definite upswing starting this month.

Airframe manufacturers put on the strongest display of their lines ever seen at one of these conventions. Complete lines of business aircraft were shown both statically in downtown Philadelphia at the Penn Center and the Philadelphia International Airport, where attending pilots were given opportunity for free demonstration flights.

Spotlighting the aircraft display was lineup of five turbine-powered executive aircraft at the airport, which provided tangible evidence that business flying's jet age has arrived. The lineup included Lockheed Jetstar, Grumman Gulfstream, Fairchild F-27, Convair YC-131C and Beech Morane-Saulnier MS 760 Paris jet, all of which participated in a flyby Wednesday of some 19 different types of business and utility aircraft. Included in the flyby were new versions of the Bell 47J Ranger an Omega BS-12 twin engine helicopter, Vertol 44, Hiller UH-12E and turbine powered Sikorsky S-62, Vertol 107 and Republic Alouette.

Lockheed, Grumman and Fairchild report that they now have a total of 112 orders for executive versions of their new aircraft. Lockheed says it has 70 production line positions for the Jetstar assigned to corporations and Grumman says it has sold 27 Gulfstreams, with the first production airplane going to Sinclair Refining Co. early next year. Fairchild notes that the recent purchase of an F-27 by R. J. Reynolds Tobacco Co. brings its tally of executive customers to 15.

Others include Continental Can Co., General Tire & Rubber Co., Butler Aviation, Bank of Mexico, Westinghouse Electric Corp., Ideal Cement Co., Champion Spark Plug Co. and Kimberly-Clark Corp.

Jetstar stirred considerable interest due to the first public appearance of Pratt & Whitney Aircraft Division's new 2,900-lb. thrust JT-12 turbojet engine at the convention and the announcement that this powerplant will be available for installation on the Jetstar. Pratt & Whitney made a strong showing at the NBAA convention to throw its turbine powerplant hat into the business flying market, in competition with General Electric J85 and Wright TJ37. The JT-12 also is suitable for installation on the North American Sabreliner and the four-jet McDonnell UCX 119, not yet rolled out.

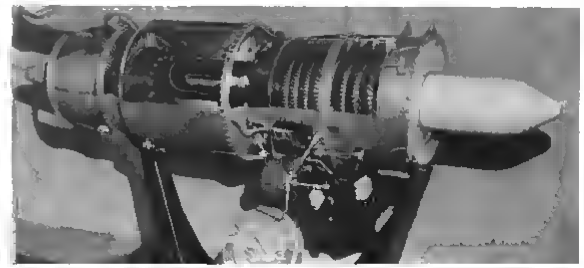
Pratt & Whitney says that it expects to make production deliveries of JT-12s suitable for manned aircraft installation beginning in October 1960, and indications are that the engine will be highly competitive in price with the General Electric, Fairchild J83 and Wright engines.

Design Simplicity

Price of the JT-12 probably will be under $80,000. JT-12 has been running on test since May 1958, and completed a 50-hr. endurance run last month. Weighing only 430 lb., the single spool axial flow engine has a thrust-to-weight ratio of 6.75 to 1. Specific fuel consumption is .93 at takeoff thrust rating and .89 at maximum cruise power of 2,140 lb. thrust in its commercial configuration. Military model, designated T60, is planned for operation beyond Mach 2.

Major reason for the low price of the new engine is emphasis on design simplicity. Pratt & Whitney engineers stayed away from employing new fabrication methods and relied on proven techniques. The engine has only three bearings; a simple single fuel nozzle is used in place of the usual cluster of nozzles in each combustion chamber and many accessories are scaled-down versions of those used in larger airplanes.

New specifications for Jetstar with four JT-12 powerplants show that it will have a long range cruise speed of 526 mph. true airspeed at 45,000 ft. compared to 518 mph. with four J85s and 505 mph. for two Wright TJ-37s under the same conditions. Speed for maximum rate of climb goes up to 368



CUTAWAY version of Pratt & Whitney JT-12 2,900 lb. dry static thrust turbojet was displayed publicly for first time at National Business Aircraft Assn. annual convention, Philadelphia. Lightweight (430 lb.) engine completed a 50 hr. endurance test last month. Engine is scheduled for use in the McDonnell UCX transport (AW July 28, p. 29), possibly in missiles drones and commercial aircraft. Single spool design is aimed at low specific fuel consumption. The JT-12 provides 6.75 lb. thrust per pound of engine weight.

Thor Delivered to RAF for Missile Squodron Training

Douglas Thor intermediate range ballistic missile is delivered by the U.S to the 77th Strategic Missile Squadron, Royal Air Force, at Feltwell, Norfolk, England Decision to fire the 1,500 mi range missile would have to come from both the U S. and British governments.

mph with JT 12s, compared to 330 mph with J85s and 355 with TJ 37s Lockheed also reports that the JT 12 installation will sharply cut Jetstar takeoff and landing requirements Takeoff length field at full gross weight of 37 000 lb is given as under 5,000 ft with JT 12s slightly over 6 000 ft with J85s and slightly over 8,000 ft with TJ 37s

Grumman announced a substantial price increase for its Gulfstream here, now quoting the airplane cost at $845, 000, minus interior and radio Previous airplane price was approximately $700,000

Forthcoming heavy activity in selling large numbers of Convair liners being released by airlines in preparation for turboprop and jet operations to the business and aircraft user also was prominent here Frederick B Aver and Associates, which recently contracted to purchase 24 Convair 240s from American Airlines, has reached an agreement with AiResearch Aviation Service Co Los Angeles Convair conversion specialist, to provide "executive Aver Liners" with a completely new interior for business use at $385, 000

An airline configuration of the airplane will sell for $250,000 Aver says that the first executive conversion of the former AA240 now is going through AiResearch shops and will start a two-month demonstration tour around the country starting Oct 12

Allison has signed an agreement with PacAero Engineering Corp , Santa Monica under which PacAero will handle conversions of 340s and 440s to take Allison 501 D13 turboprop engines PacAero is shooting for a target date on Nov 1 for Civil Aeronautics Administration certification

Canada to Use Boeing Bomarc; Tightens U.S. Procurement Ties

Washington—Close U S Canadian cooperation in the design and production of advanced aerial weapons probably will begin within the near future, with each country depending upon the other for vital components in their common weapon systems

First implementation of the new international purchasing policy was evidenced by the Canadian decision to incorporate the Boeing Bomarc interceptor missile in Canada's air defense system, a move announced by Prime Minister John Diefenbaker last week and reported by AVIATION WEEK on Sept 1 (page 26)

The Canadians also have dropped their promising Mach 2-plus manned interceptor, the Avro CF 105 Arrow, and only 37 flight test copies will be produced unless U S or NATO orders save the aircraft

Long-standing Canadian policy of maintaining domestic sources for production of defense equipment probably will be set aside in the case of the Bomarc and its ground control system Canadair will produce the Bomarc airframe in Montreal, but no definite decision has been made as to production of powerplant and guidance systems. Due to the heavy costs involved authorities in Ottawa are leaning toward U S suppliers rather than incurring the added expense of creating Canadian sources.

All indications are that the Canadian government is not taking unilateral action in considering increased Canadian dependence upon U S industry The U S and Canadian weapon development effort will be more closely integrated in the future and a greater number of U S design and production contracts will be placed in Canada. There is great Canadian reluctance to allow design teams that have produced advanced equipment such as the CF 105 and the Iroquois turbojet engine to die.

A change in Canadian military doctrine also is involved in the Bomarc and CF 105 decisions Last year, Canadian Defense Minister G. R Pearkes, Air Marshal C. R Slemon, of the Royal Canadian Air Force, and other officials were clear in expressing their belief that manned interceptors were essential to a well-balanced air defense. They definitely did not consider an all missile defense to be satisfactory

Present funding for the CF-105 is $303 million which will pay for the 37 flight test aircraft The aircraft will not be completely equipped Only a few models of the Arrow's complex fire control and navigation system will be built for test purposes One hundred Arrows completely equipped would cost an additional $1 250 million

The Canadian Bomarc will be located at two bases in northern Ontario and Quebec areas according to the present plans and will be operated by the RCAF

John Diefenbaker, in revealing the change in Canadian defense policy, said that Canada will strengthen the Pine Tree radar system to control more effectively the increased speed and numbers of aircraft involved

The Canadian decision meant these major steps

• Adoption of SAGE (semi-automatic ground environment), which entails discussions with the U S for supply of the large computers needed and to arrange for Canadian industry sharing in production of the total equipment required System would be used with Pine Tree line

• **Cancellation of the Sparrow II** project being carried on by Canadair Ltd Canadair has a laboratory under construction for this project but a relatively small staff involved

• **Cancellation of Astra,** a special flight and fire control system for the Avro CF-105 A fire control system and weapon now in production in the U S will be used instead Probably the weapon will be Sparrow III

Diefenbaker said it would cost $1,250 million in addition to the $303 million already spent to finish the Sparrow II Astra programs and provide about 100 CF-105s By making the reductions scheduled, unit costs which would have amounted to about $12.5 million an airplane under this program can be reduced to $9 million

"As the age of missiles appears certain to lead to a major reduction in the need for fighter aircraft, Canada cannot expect to support a large industry developing and producing aircraft solely for diminishing Canadian defense requirements," Diefenbaker said

IT&T Wins Contract For SAC Control Unit

Washington—International Telephone and Telegraph Corp has been selected by Air Force to develop and produce its new Strategic Air Command Control System (SACCS) New global data processing system is intended to keep the SAC commander continuously posted on the current state of readiness and the location of every strategic bomber and missile, including airborne aircraft (AW Sept 1, p 15)

New SACCS, identified as supporting system 465L, is expected to slash the time delay in obtaining readiness status information from several hours to a matter of minutes, according to an Air Force spokesman

Air Force has programmed $32.6 million for the program from Fiscal 1959 funds, but the system is expected to cost approximately $150 million before it becomes operational

New control system will consist of information entry devices at every SAC base, each connected to a central computer at SAC headquarters near Omaha, plus associated displays to quickly indicate the readiness status at bases throughout the command

Information on the number of operational aircraft, location of those on missions and estimated time to repair non-operating aircraft will be punched into information entry devices at each SAC base on an around the clock basis, keeping the central headquarters computer abreast of the existing situation

International Telephone and Telegraph was selected in a competition with 14 other companies that submitted seven individual or team proposals

Clouds Dissipated In Test With Carbon

Washington—Navy has created and destroyed clouds by seeding with carbon-black particles two-millionths of an inch in diameter Seven clouds, seeded over the south Georgia coast from a Lockheed WV-3, were dissipated in from 2½ min to 20 min. Typical cloud ranged from a base at 5,000 ft to a top at 11,000 ft

Seeding also formed three single clouds and one line of clouds Liquid carbon solution, poured over a mile long track at 4,000 ft, formed a line with bases at 3,000 ft and tops at about 6,000 ft

Experiments were conducted last July 29 31 by Naval Weather Service under the direction of Dr Florence W van Straten

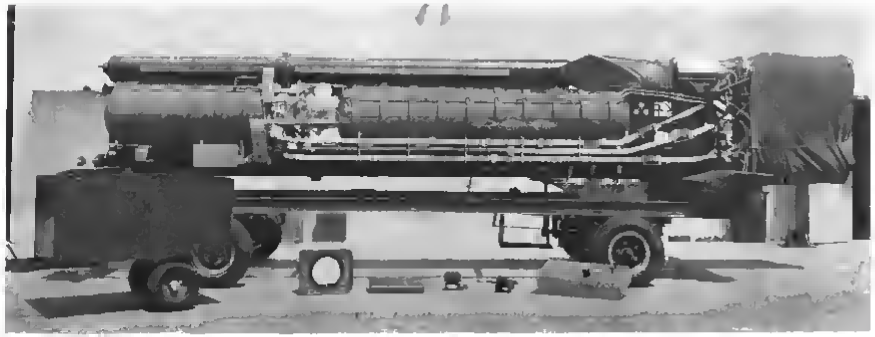
Carbon used ranged from 1½ lb dry packages to 6 lb suspended in liquid Dr van Straten and Dr J E Dinger, head of aerology branch of the Naval Research Laboratory, had conducted preliminary laboratory experiments

Navy said the air tests demonstrate feasibility, and the next steps are a study of cloud physics, attempts to effect fog, stratus clouds and thunderstorms, and if these are successful, "the exploitive stage"

NRL scientific advisor R E Ruskin, and his assistant Donald Purdy of NRL, worked with Dr Straten Cmdr Nicholas Brango of Navy Airborne Early Warning Squadron Four at Naval Air Station, Jacksonville, directed air operations

Hughes Unveils GAR-3 Falcon

Most recent Falcon air-to-air guided missile, GAR-3 (left), is powered by a longer-lived solid propellant rocket engine, according to Hughes Aircraft Co. Predecessor Falcon GAR 1D (right), is powered by a Thiokol engine. Missiles use radar homing GAR 3 has a ceramic nose cone manufactured by Corning Glass Works which is resistant to effects created by high speed and temperature GAR 3 has longer airframe, greater wingspan and extended stabilizers in comparison with GAR 1D.



COLEMAN engineering pusher sled powered by three modified Aerojet Bomarc engines, propels 2,500 lb to Mach. 2.

MISSILE testing has been added to seat ejection tests on aircraft such as B-52, F-105 at USAF's Hurricane Mesa track.

Space Technology

Air Force Sled Track Adapted for Missile

By Evert Clark

Washington—Air Force's supersonic rocket sled test track at Hurricane Mesa, Utah, is now being used for air-to-air missile testing and is being considered as a free-flight launcher for larger staged missiles and space vehicles.

One of the facility's first space tasks will be the testing of the escape capsule for the North American X-15 rocket research vehicle.

Unique features of the Hurricane Mesa site include a 1,500 ft. drop from the end of the track to the valley below, which means that many test items can be recovered, and the 75 mi. of uninhabited country available beyond the end of the mesa for an instrumented free flight range. Instrumentation now runs approximately 5 mi. out from the mesa.

The facility, formerly known as the Supersonic Military Air Research Track (SMART), is called Hurricane Supersonic Research Site (HSRS). It was built for Air Research and Development Command's Wright Air Development Center in 1955 by the Coleman Engineering Co., Inc., of Torrance, Calif. Coleman also is operating contractor.

When the 12,000 ft. dual rail track was built, it was planned primarily as a seat ejection test facility and also as a research tool to advance the art of rocket sled testing.

First two years at HSRS were occupied chiefly with tests of ejection systems. These have included the Republic F-84, North American F-86, Northrop F-89, Lockheed F-94, Boeing B-52, Convair F-102, Lockheed F-104, Chance Vought F8U-1, high speed tests on the Martin-Baker seat and tests of the Convair and Lockheed industry ejection systems.

This work has contributed to techniques of testing and sled design, and has progressed in the past year into testing of the top speed capability of parachutes at speeds up to Mach 1.5 for recovery of small air-to-air missiles.

One result of what has been learned is that special sled vehicles duplicating the cockpit of the particular aircraft are now being used when a seat is tested, because specific airflow around a nose configuration directly affects behavior of the seat at ejection, and also affects seat design.

Recently, there have been countermeasures tests against air-to-air missiles. Missile is carried along the track and fired from the sled at a target several miles out from the end of the mesa. Counter-measures are used against the missile in an attempt to confuse it and throw it off course.

Coleman contends that there still is inadequate application of track testing and estimates that perhaps one-half of the track testing being done is devoted to problems that were not visualized five years ago.

In addition to continued testing of seats and capsules such as the Stanley Aviation Corp. escape system for the X-15, Coleman has either conducted or proposed to USAF these uses of the Hurricane Mesa track:

- **On-track or captive testing.** Representative work includes test of chaff dispersions flutter, blast or gust loads, ram erosion, aerodynamic tests, sonic boom damage evaluations, high-speed wire laying, linear acceleration, impact tests and use of a venturi high Mach generator on the sled as a traveling wind-tunnel. Tunnel speeds of Mach 6-8 for several seconds are considered feasible and Mach 15 is considered possible.
- **Over-the-cliff tests.** Photographic and electronic instrumentation along the track and in the recovery area below the cliff, plus the use of telemetry, provides information on the complete operational cycle from beginning of the run to impact. Types of tests include air blast, impact, tests of cargo containers, electronic marker beacons and survival equipment.
- **Seat escape systems.** In addition to tests with instrumented anthropomorphic dummies, tests have been run with live subjects. Both subjects and expensive test items are recovered by parachute. Live subjects have been recovered after runs at Mach 1.3.

Ted C. Coleman, president of Coleman Engineering, believes the real potential of the facility that has not been tapped so far is its use as a free-flight range, a feature no other test track has. He believes also that test tracks generally have not been adequately reorganized as the intermediate dynamic testing tool between wind tunnels and actual full-scale flight.

Free flight tests of missiles would be useful first because of economy and because the sled provides an additional booster that can accelerate a heavy vehicle to as high as Mach 2.5 before stages of the missile itself are fired. Test vehicle with a 10,000 lb. weight has been discussed as a design objective.

Free flight could be used to test:

- **Missile stage separation.**
- **Missile firings against** moving targets launched from the valley below.
- **Missile stability or component** tests, such as guidance and control.
- **Fuel sloshing in an instrumented** section simulating the fuel tank portion of a missile. Programmed course variations can be induced and the effect of sloshing measured by airborne and ground cameras.
- **Bio-physics capsules** for aeromedical research work.
- **Tests of missile fin opening,** cross wind firing and warhead or warhead decoy explosion patterns.

Coleman now has a six-ton, three barrel pusher sled in preliminary flight rating tests. It is powered by three Aerojet-General Corp. liquid fuel Bomarc rocket engines, using red fuming nitric acid and JPX. Coleman designed and built the support equipment. Aerojet says the sled can push a payload of 2,500 lb. to a velocity of 1,600 mph. Coleman says a top speed of Mach 2.5 could be reached, using newer propellants. Limitation on rocket sled speeds still is considered to be primarily one of the life and strength of the slippers.

Extensive modification of the track's water brake system was required for the new sled. Normal braking load of 300,000 lb. was increased to some 600,000 lb.

Length of the track is 12,000 ft., but full length is not used in all runs. It can be extended to 17,000 ft.

MISSILES or space vehicles launched from Utah track get effect of extra booster drive 75 mi. free flight range.

DROP of 1,500 ft. from mesa to valley makes recovery of test items possible.

Economic Role Seen For Space Scientists

Ft. Worth—Scientists and engineers have increasingly important roles in making economic decisions on new weapons at both business and government levels, C. J. McCarthy, board chairman of Chance Vought Aircraft, told a Texas Section meeting here of the Institute of the Aeronautical Sciences.

Observing that it would cost more than $400 billion to complete all the realistic space projects proposed by qualified scientists, McCarthy said the decisions on which projects to develop are linked to the ability of managers to analyze pertinent information and judge its relative importance.

Faced with inevitable financial limitations, both government and industry must integrate their scientists and engineers in the decision making structure, McCarthy said. This means that scientific personnel must not only understand the technical aspects of a problem, but must also know of the other resources available for the job.

Various economic pressures make it difficult to make decisions "in which we have complete confidence," McCarthy said. "We frequently have to take rather outrageous gambles, either on the financial side or on the scientific side, as we turn down some very promising projects which the opposition might pick up and capitalize on. Nationally, this is just about what we did in the large rocket propulsion field in the late 1940s and early 1950s."

Discussing aviation economics, McCarthy observed that the airframe industry has had an average profit on sales of 2.5% in the 1946-57 period, while the average for all major U. S. manufacturers was 6.3%.

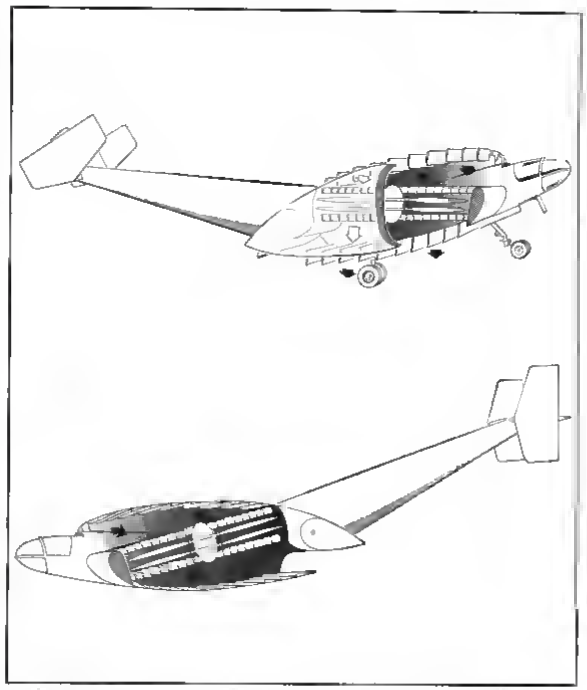
He told the IAS group that this low return is a serious handicap and means a severe strain on financial resources to meet responsibilities in research and development and, at the same time, to increase production capacity and make major changes in techniques.

The aircraft industry is investing heavily in new facilities in spite of a surplus of factory space built for conventional aircraft production, and the industry is now in the seventh year of a 10 year, $2 billion private financed expansion program.

Renegotiation Act was described by the Chance Vought official as another roadblock to progress. He said that the situation no longer exists where clearly excessive and unreasonable profits can be made. "Large contracts are now either cost plus fixed fee or incentive type. I do not know of any instance where an excessive profit has been made on cost plus fixed fee contracts—it just can't be done."

Goodyear Aircraft Corp. is making an aerodynamic study for the U. S. Army of a VTOL aircraft powered by two combined rotors housed in the wing/fuselage area. Aircraft would make the transition from forward flight to hovering by changing direction of airflow.

Goodyear Tests Single-Powerplant VTOL



Airfoil-shaped louvers in Convoplane's upper, lower wing surfaces open to permit movement of air from above aircraft downward through rotor, providing thrust for hovering (top). When louvers are closed, air is ducted through wind leading edge and expelled through trailing edge (bottom). Concept is being tested at Akron, Ohio.

Space Technology

NASA to Open Doors on Oct. 1; Laboratory Names Are Modified

By Ford Eastman

Washington—Plans and programs of the new National Aeronautics and Space Administration have progressed to the point where Dr. T. Keith Glennan, NASA administrator, will proclaim the agency organized and ready for business beginning Wednesday. The proclamation beats the 90 day deadline set by Congress by approximately one month.

At the same time that NASA becomes a reality, the 43 year-old National Advisory Committee for Aeronautics will cease to exist and its personnel, facilities and functions will be absorbed by the new agency.

Although details of the organizational structure of NASA will not be announced until later, these changes will become effective with the changeover from NACA to NASA:

▪ **Names of Langley Aeronautical Laboratory**, Langley Field, Va., Ames Aeronautical Laboratory, Moffett Field, Calif., and the Lewis Flight Propulsion Laboratory, Cleveland, Ohio, will be changed to Langley, Ames and Lewis Research Centers. Names of other NACA centers will not be changed.

▪ **The 28 advisory committees** and subcommittees, now a part of NACA, will be reconstituted as advisory committees to the NASA until the end of the year in order to complete their activities. At that time, they will be abolished.

Most of the existing policies under which NACA now operates will remain in effect until they are no longer applicable.

Meanwhile, another step toward developing a national space program was taken last week when the President called a meeting of the National Aeronautics and Space Council, a nine-member high policy group headed by the President.

The council was created by the same act that established NASA to survey, develop and designate direction of all significant aeronautical and space activities through the President. NASA will have responsibility for non-military space activities, while the Defense Department will continue to be responsible for space activities of a military nature or those associated with national defense.

Attending the meeting, besides the President, were Defense Secretary Neil McElroy, Undersecretary of State Christian Herter, an alternate to John Foster Dulles, Secretary Dr. Keith Glennan, Dr. Alan Waterman, director of the National Science Foundation; Dr. Detlev Bronk, president of the National Academy of Sciences.

Dr. James Doolittle, vice president and chairman of the board of Shell Oil Co., William A. M. Burden, president of the William A. M. Burden Co., New York. Willard F. Libby, member of the Atomic Energy Commission and alternate to the chairman, and White House aides Gordon Gray, Karl Harr and Dr. James R. Killian, Jr.

A White House spokesman said the council plans to hold meetings about once a month but that most of the subjects discussed probably would not be disclosed since national policy is involved.

Congress, in creating NASA, specifically directed the agency to "provide for the widest practicable and appropriate dissemination of information concerning its activities and results thereof." The council was so directed.

However, Congress did call upon the President to submit a report in January each year which shall include the following:

▪ **Comprehensive description** of the programmed activities and the accomplishments of all agencies of the U. S. in the field of aeronautics and space activities during the preceding calendar year.

▪ **Evaluation of such activities** and accomplishments in terms of the attainment of, or the failure of, the objectives described in the act.

▪ **Such recommendations** for additional legislation as the administrator or President may consider necessary or desirable for the attainment of the objectives.

Reports on activities and accomplishments of National Aeronautic and Space Administration must be submitted to Congress at least twice a year.

Polaris Failure

Cape Canaveral, Fla.—First two-stage test vehicle of the Polaris intermediate range ballistic missile was destroyed by the range safety officer 43 sec. after its launching from Air Force Missile Test Center here last week.

Primary purpose of the firing was to test the guidance and control system by operating the solid fuel engine of each stage for a short time, obtaining precise thrust termination in each stage by blowing a panel in the side of the engine and dropping internal pressure below the minimum required to keep the propellant burning and operating the stage separation devices and maneuvering the missile during powered flight. Range of the flight was to be well below maximum.

This test program came to an end when the pitch axis programmer failed to accomplish the first task set for it—to turn the missile from a vertical to a southeasterly path. The missile was destroyed a few thousand feet above the firing pad and large portions of it fell near a populated section about five miles away. No one was injured and no property damage was reported as a large piece of the missile exploded on impact with the ground and one large piece fell into the Banana River.

News Digest

Modification orders for development of an airborne drone surveillance system for U. S. Army Signal Corps, totaling $22 million in new work, have been received by Fairchild Engine and Airplane Corp. Orders increase to nearly $48 million the total contract.

Lockheed Missiles Systems Division has established a Spacecraft Department within its research and development branch to conduct studies of vehicle configurations for future space regimes. Key activity will be study of structures, another activity will be work on space station technology.

Air Force Boeing Bomarc interceptor Missile, triggered from a SAGE post at Kingston, N. Y., last week successfully intercepted a supersonic X-10 target drone after launching from the Air Force Missile Test Center, Cape Canaveral, Fla. Drone crashed and burned on landing but radar and telemetry confirmed the first successful supersonic intercept by the Bomarc.

General Electric Co.'s CJ-805 commercial turbojet engine received final type certificate from CAA.

American Machine & Foundry Co. has completed engineering study contracts for Convair-Astronautics Division of General Dynamics Corp. embracing transportation, handling and launch equipment for the Atlas ICBM.

Government sponsored program to develop lightweight, moderate-cost distance measuring equipment (DME-T) for private flyer and general aviation will be announced shortly by Airways Modernization Board and Civil Aeronautics Administration. Two agencies are preparing specifications for the "poor man's DME-T," and will hold briefing session for prospective bidders in the near future.

Airlines Set Stage for United Labor Front

ATA president scores bargaining tactics, demands of ALPA; union leader issues sharp rebuttal.

By L. L. Doty

Washington—In its first public attack against the Air Line Pilots Assn, the airline industry last week bluntly scored the bargaining tactics of the union and the pay of its members to bring the smouldering differences between the two groups into sharp focus.

Charging the pilots with keeping the airline industry on a constant merry-go-round, Air Transport Assn President Stuart G. Tipton called upon the union to accept a "sense of responsibility" in labor-management relations. Tipton made the charges in an address delivered before the Boston Rotary Club last Wednesday.

This first attempt by the industry to air its controversial problems with the pilot group in the open at once drew bitter rebukes from the union president, Clarence Sayen, in Chicago. It is expected to touch off a series of clashes between the airlines and their pilots which may block the way to inauguration of jet service on target dates late this year and early next year.

The speech, which had the tacit backing of at least eight airline heads but was not necessarily cleared by the industry generally, is being construed here as setting the stage for a new get-tough policy by the airlines with the pilots' union.

Airline Plan

Such a policy will be backed by at least one of two plans which the scheduled airlines have been discussing secretly for the past two years as a means of pulling more power to their side of the bargaining table. Neither plan has yet drawn the unanimous support of the industry, but most observers feel that—although Tipton made no reference to it in his speech—the Boston blast will trigger a renewed industry move to put the plans into action.

First plan, which is now being balked at by only three airlines—reported to be National, Pan American and TWA—calls for the organization of a joint negotiating committee that will represent the entire industry in all individual disputes with the pilots.

As a bulwark against strikes or the threat of strikes, the airlines will protect themselves with an industry-wide insurance coverage, presumably to be underwritten by Lloyds of London, that will give financial help to any airline grounded because of a strike.

The second plan, which is less likely to be implemented because the industry is sharply split down the middle for and against it, calls for legislation that would switch jurisdiction of labor negotiations from the Railway Labor Act, the law presently covering the airline industry, to the Taft-Hartley law.

Carrier Support

Those carriers supporting the switch feel, as Tipton worded it, that "ALPA is often able to use the machinery of the Railway Labor Act to its own advantages." Opponents of the plan fear that the more stringent character of the Taft-Hartley Act might result in such tactics as slow-downs and excessive absenteeism as means of winning benefits.

Although Tipton did not touch on either plan, he did make references in his speech to the problems that might feasibly be settled by the joint negotiating committee. He said:

> An economically powerful union can employ the 'whipsawing' technique so effective in railroad and maritime labor history. The technique calls for playing one airline off against another and one concession against another. At a later date, concessions made by the various individual carriers are consolidated into an agreement embodying all the objectives that the union originally set out to attain.

Tipton charged that "between 15 and 20 airlines at a given time are involved in one phase or another of negotiations by ALPA" and added that between now and the end of 1959, 21 existing contracts will expire and have to be renegotiated.

He accused ALPA of using the strike threat at least once during virtually every negotiation of a contract and pointed out that the strike threat can be used to "attempt to drive customers away during the preliminary war of nerves."

Sayen Rebuttal

ALPA president Clarence Sayen, told AVIATION WEEK that Tipton's statements were "misleading." He said that, during the 27 years of ALPA history, 995 contracts have been negotiated and that only three strikes have been called because of "economic issues."

Since 1951, he said, there has been only one strike because of economic reasons—the recent strike earlier this year against Western Airlines—and that he said was a "completely unnecessary" strike.

Sayen accused Western's management of "egotism and meptness" in negotiations and added that "most airline managements are completely out of touch with the basic problems" of the industry.

Here is the latest boxscore on current negotiations between the Air Line Pilots Assn. and the airlines:

- **Caribbean Atlantic, Bonanza** and Piedmont pilots have taken strike votes.
- **Western Air Lines** is in arbitration. Company will present its case Nov. 19 on the total of 19 issues involved.
- **American, Eastern, Great Lakes,** Northeast, Panagra and Pan American are in mediation.
- **Waiting** negotiations are California Eastern, Pacific Northern, Seaboard and Western, Trans Ocean and Trans World Airlines.
- **West Coast Airlines** is before a fact-finding board.

Profit Margin vs. Pay

Tipton called attention in his speech to the industry's "dangerously low" profit margin resulting from the rising expense level and the "government ceiling on prices." He said the biggest item of expense to the industry is the payroll and added:

> "The highest paid group of airline employes are the pilots who constitute less than 10% of the total airline work force but receive over 20% of the total payroll." He estimated the average income for captains who flew as captains throughout the 12 months of the year to be $17,718 in the domestic trunk industry and $22,288 in the international field.

Tipton said the Air Line Pilots Assn is demanding as much as $45,000 per year for pilots flying jet aircraft.

Sayen replied to these statements with charges that the airlines have created their own "economic chaos" and now expect employes and the government to "bail them out." He accused the industry of foot-dragging on such matters as airport development and air traffic control problems and added that there has been no preparation for the jet age by those airlines who "wanted to jump into jet operations overnight."

"Now the airlines want the employes to accept whatever burden that comes with this lack of preparation," the ALPA president said.

Sayen emphasized that the average salary of pilots is $12,500 a year and claimed that Tipton was "misleading" by averaging wages of top pilots with 20 years of service as a means of making his point.

ALPA Rebuttal

Sayen contended that the speech was characterized by the philosophy of just a few airlines, not all the 52 companies represented by ALPA and added that the two carriers dominating the Air Transport Assn. are American and Pan American.

In a fact finding sheet issued by ATA in conjunction with the speech, it was pointed out that trunk line carriers have reported a total of 696 pilots who received flying pay in excess of $20,000 last year.

This compares with the 133 company officers and employes of the trunk line industry who last year earned $20,000 or more.

In support of the second plan of the carriers to battle the pilots' union, Tipton devoted a large portion of his talk to the "archaic" laws governing the pilots' union. He referred to "Decision 83"—a concept issued in 1934 by the old National Labor Board.

Decision 83

Decision 83 was incorporated in the Civil Aeronautics Act of 1938 and last summer was carried over into the Federal Aviation Act of 1958 without any public protests from the airlines. Because it is carried within the law, ALPA is the only union which has working conditions, rate structure and working time limitations covered by a federal statute.

Tipton stressed that the safety factors and the short working life provisions, as well as the various productivity phases of Decision 83, are "completely inconsistent with the facts of today."

On the point of safety, he said that risk calculators who determine life insurance rates offer the same premiums for "airline pilots as applies to house painters."

Referring to the "short working life" of a pilot, he said that 80% of the pilots employed by one major carrier in 1937 are still on the payroll and that six of them are now over 60 years of age.

Productivity provisions, he said, ignores increased maintenance costs, capital outlay and other related factors stemming from technological advances and added, "by relating pay to specific productivity of one piece of equipment, the pay of a select few may . . . suddenly skyrocket to extreme and disproportionate heights."

PanAm Plans to Start Jet Flights Despite Airport Clearance Doubts

New York—Pan American World Airways last week went ahead with plans to begin transatlantic jet service Oct. 26 despite further uncertainties about where and how the jets will be allowed to operate.

By mid-week the airline had received no official clearance for its Boeing 707-120s at New York International Airport, Le Bourget Airport at Paris, Ciampino Airport at Rome, or London Airport.

These new developments added to the confusion:

- **Italian Under Secretary** for Air Senator Giuseppi Caron said at a press conference that the Pan American jets wouldn't be able to serve Ciampino because of traffic control problems. This statement was unofficial, however, and other Italian authorities denied that a ban was being considered. Caron later said that his statement had been made before Pan American had submitted its schedule of jet operations and he now says the problem is a technical one and he does not expect to comment further until he can do so officially.
- **Paris airport** spokesman denied reports that new restrictions might be set on operation of the 707 at Le Bourget. The airplane's noise tests at Paris this month were "completely satisfactory," the spokesman said, and the airport is "open for Boeing operation." But the spokesman added that further noise tests would be held in late October or early November.
- **Port of New York** Authority Executive Director Austin J. Tobin (AW Sept. 8, p. 39) and Director of Aviation John Wiley turned up last week at Paris at a meeting with London and Paris airport authorities. Comment was withheld on the substance of the meeting by all parties except for the statement that it was "technical." This statement came from the Paris airport spokesman; the New York agency described the session as a "routine meeting with European airport operators to discuss mutual operating problems." Reportedly under discussion was a common system of controls for the jetliners. Regarding the meeting, a Pan American spokesman said, "we weren't invited to sit in on it and they didn't advise us of their findings."
- **British newspapers** were playing up reports that 707 restrictions at Paris and elsewhere were in the works. This was cited as a factor in the race between British Overseas Airways Corp. Comet 4s and Pan American 707s for first transatlantic jet services. Some British papers were running page one headlines proclaiming that the Comet 4 was

Boeing 707 Receives Certification

Certificate of airworthiness for Boeing 707 jet transport is presented to William H. Allen, right, president of Boeing Airplane Co., by James T. Pyle, left, Civil Aeronautics Administration administrator, and Sinclair Weeks, Secretary of Commerce. The 707 is the first American turbojet-powered transport to receive CAA certification.

winning the race and would beat the 707 onto the Atlantic

The Italian official's statement aroused a variety of interpretations. In Washington, it was construed as a pressure move designed to force the United States into granting more route concessions to Alitalia, the Italian flag carrier.

Although the Italian government has made no official bid to reopen talks on the bilateral agreement with the U. S., the subject was recently raised with the U. S. ambassador in Rome. State Department officials believed this was a prelude to new demands by Italy that Alitalia's routes be extended within the U. S. beyond the Boston and New York gateways now served.

Jet noise, which has been the major stumbling block to clearance at Idlewild, was not considered a factor in the Rome situation. Ciampino is far out from the city. Traffic control, however, may be a real problem at the Italian airport.

PanAm plans initial service from New York to Paris and Rome on the Oct. 26 date. New York-London service is scheduled to follow on Nov. 16.

Eastern Asks Lease Investigation

Washington—Eastern Air Lines moved last week to block an impending lease and stock exchange agreement between Pan American and National Airlines (AW Sept. 15, p. 38) by calling for a full-scale Civil Aeronautics Board investigation of the proposal.

As filed with the Board, the three-part agreement calls for a mutual exchange of 400,000 shares of common stock between the carriers plus an option by Pan American to purchase an additional 250,000 shares; the short term lease to National of Boeing 707-121 jet transports for the next two winter seasons beginning Dec. 10, and a long term lease for the two-way rental of 707s and Douglas DC-8s for the next 10 years.

The latter agreement would allow Pan American to strengthen its equipment program during the transatlantic summer season and aid National in meeting its winter requirements. National would thus gain a competitive advantage over Eastern and Northeast airlines by introducing the first jet equipment over the New York-Miami route in addition to earning equity capital to finance its jet program through the stock option provision.

A further stipulation of the stock option tailors Pan American's purchase to the expected high load factors for the first jet flights on the Florida route.

Over a three-year period, Pan American would be authorized to buy the 250,000 extra shares at $22.50 a share based upon an expected load factor of 80%. For each point below this percentage, the carrier would be restricted to 8,333 shares less, according to the agreement.

While the two carriers have filed the proposal as three separate agreements, Eastern contends that the application is a "one package" deal which would result in the control of National by Pan American through the acquisition of 36% of National's outstanding stock by 1961.

Eastern further contends that each part of the agreement is interdependent to the other and has asked CAB to maintain the status quo of the parties pending a hearing.

Attorneys for Eastern said failure to act on this request could result in the inability of the Civil Aeronautics Board to exercise its statutory powers over the agreement either before or after the proposal is consummated. As filed by the airlines, the agreement asks a CAB ruling relinquishing the need for formal approval of the long term lease section, a ruling on the stock transaction that there will be no acquisition of control or approval of such acquisition and serves notice that the parties are not seeking CAB approval of the short term lease provisions filed under Section 412 of the Civil Aeronautics Act which does not require Board approval.

Eastern claims the agreement would be in violation of Section 408 of the Civil Aeronautics Act which calls for CAB approval of acquisition of control of any air carrier.

A subsection stipulates a hearing to determine if any violation has taken place but it would have to be invoked almost immediately to prevent Pan American and National from placing the proposal into immediate effect, Eastern attorneys said.

Actual control of National could come about at a Nov. 7 stockholders meeting of the airline and approval of the delivery of 400,000 shares, or 26% of the National stock to Pan American three days later, the Eastern attorneys said.

Lockheed Boosts Range of Electra

Los Angeles—Lockheed Aircraft Corp. last week announced it has increased the flight range of its turboprop Electra transport from 2,750 to 3,460 mi. by increasing the aircraft's fuel capacity.

Added fuel capacity, according to the company, will be about 900 gal. and will permit operation of transcontinental flights with a two hour fuel reserve.

On a recent test flight, the plane was flown 2,775 mi. nonstop from Burbank to Brunswick, Me., with a sufficient fuel reserve to cover another 690 mi. and 45 min. holding time. Block speed on the flight was 411 mph.

According to Northeast Airlines, the additional fuel would be added to the aircraft with fillet tanks at a modification cost of about $11,000 per aircraft. Northeast, which has 10 Electras on order with an option for an additional two, has ordered the modification for its fleet.

Total fuel capacity of the modified aircraft will be increased from the standard 5,506 gallons to 6,406 gallons for airline operations. Lockheed also is understood to be increasing the total takeoff weight of the plane from 113,000 lb. to 116,000 lb. to permit transcontinental operations.

FCC Acts to Relieve Telemetry Congestion

Washington—Federal Communications Commission has acted to relieve congestion in the present airborne telemetry band (215-235 mc.) with the allocation of a 100 megacycle band of the spectrum in the 1,435 to 1,535 mc. region.

The commission's action followed a petition filed early this year by the Aeronautical Flight Test Radio Coordinating Council representing members of the Aircraft Industries Assn. Council Chairman R. E. Winslow of Boeing Airplane Co. praised the FCC for its prompt action.

New 1,435-1,535 mc. band has been under discussion by telemetry manufacturers and users for some time, so FCC's action comes as no surprise. An Aviation Week check of several telemetry manufacturers reveals general approval and enthusiasm for the new band, with a number of companies already developing equipment for it. They include:

- **Bendix Pacific** plans to develop both airborne FM/FM and pulse code modulation (PCM) equipment for new band, has started preliminary work, expects to have the first production units available in approximately eight months.
- **Radiation Inc.** reports preliminary design efforts in the new band but no production schedules yet. A spokesman says the company expects to produce transmitters, receivers and phase-lock demodulators for new telemetry band.
- **Tele-Dynamics Inc.** reports some airborne FM/FM type bread-board equipment for new frequency is now operating in its laboratory. The company could have initial production units ready in eight months if customers place orders soon, a spokesman said. The company expects to develop airborne PCM equipment for new frequency.
- **Texas Instruments, Inc.** says it is working "vigorously" on development of equipment for new telemetry band, that preliminary models of 1,435-1,535 mc. transmitter are already well along and production is expected within a few months.

Manufacturers generally expressed the view that the new telemetry band will accelerate the use of pulse code modulation instead of FM/FM. Limiting item on the early implementation and use of the new band may be the speed with which the military services procure and install new microwave telemetry receivers at major aircraft and missile test sites.

Rothschild Resigns

Washington—Louis S. Rothschild last week resigned as Undersecretary of Commerce for Transportation, a post he has held since 1955. Although the controversial Vacan issue was settled during Rothschild's term as undersecretary and chairman of the Air Coordinating Committee, he repeatedly drew criticism from aviation groups for failure to lead strong Commerce support to air traffic control and airport projects. He also was accused of slashing Civil Aeronautics Administration appropriations requests before the series of midair collisions prompted Congress to give the agency the funds it required. Rothschild, who said he was retiring to devote more time to personal affairs, recently made a bid to head the new Federal Aviation Agency but was unsuccessful despite the strong backing of Commerce Secretary Sinclair Weeks.

Centerline Runway Lighting Evaluated

Washington—Centerline pattern of runway approach lights and runway illumination for touchdown have been tentatively endorsed by the Civil Aeronautics Administration as a result of evaluation tests.

In a preliminary evaluation report conducted in cooperation with the Air Force, CAA found optimum configuration for narrow-gage lighting system to consist of 8 ft. bars on a 200 ft. longitudinal spacing with an inner gage width of 60 ft. Lights, in the configuration, were set to intersect the runway centerline at a distance of about 700 ft.

Development of runway surface texture by low level floodlight illumination of the surface was found to be effective in providing sensitive height indication at touchdown. Floodlights also proved to provide directional, pitch and roll guidance in the touchdown area.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

The CAA Stands Alone

About 18 months ago this author participated in a flight test program at Andrews Air Force Base in an effort to evaluate two new types of runway lighting—flush mounted units and edge flood lighting. A report of this activity appeared here in three columns last year (AW July 22, July 29, Aug. 19). Now the Civil Aeronautics Administration has issued its findings in Technical Report No. 338. It should be stated here and now that there is genuine disagreement in many quarters not only with the conclusions reached in Report 338 but also with its method of presentation. For instance, fine print on the cover page announces that "No responsibility is assumed for completeness or accuracy of this report."

Here we have a document written by Messrs. James H. Harding, Raymond C. Herner and Robert F. Gates, stamped with the seals of CAA and the Department of Commerce, United States of America, adorned with the names of Sinclair Weeks, Secretary, U. S. Department of Commerce, James T. Pyle, CAA administrator, and D. M. Stuart, director, Technical Development Center, and yet out of this entire conglomeration nobody is willing to take responsibility for the report.

Merely Private Opinion?

Is it then merely private opinion? If so I have absolutely no quarrel with it. After all, I sound off regularly. But is it fair to embellish private opinion with official seals and titles? For obvious reasons, technical data originating in the U. S. merits considerable attention abroad. This places a moral obligation on reporters, committees and agencies to report their findings in a manner which is not only objective and factual but which is not misleading. Report 338 does not meet these specifications.

It was apparent at the beginning of this program that CAA personnel were against flush lighting and were attempting to "sell" edge lights despite the fact that many persons who would have to use these lights in bad weather considered flush units superior. Edge lighting has been installed at Washington National Airport for some time and pilots are asked to comment on them. Nearly all these comments are obtained in weather above 500 ft. ceilings and 1 mi. visibilities—far above the weather minimums which are of interest to most users. These reports are bound to be favorable since few pilots have ever seen the flush, narrow gage lights. The voting therefore is one-sided.

Report Ignores Recommendations

During the one night of real testing (actual zero-zero weather) two aircraft were used at Andrews Field. One was a CAA Douglas DC-3, the other an American Airlines Convair of which I was listed as captain with a "crew" consisting of Captains W. A. Jensen, of Air Transport Assn., E. A. Cutrell, now of Air Modernization Board, and D. S. Little of American. I do not speak for these men but at a meeting subsequent to the zero-zero flights our recommendations were given to the CAA. Report 338 has ignored these recommendations—in other words, it fails to consider 50% of the evidence.

It has always been assumed in these quarters that CAA was supposed to act the part of "servant" representative for civilian users of the airspace. (The CAA itself is hardly an important user.) In technical matters, when the users need a certain gadget for their operations, the CAA should have very good grounds for attempting to override its constituents.

Many persons, some in CAA, are hard at work trying to get ready for the coming jet transports. Visual aids are vital to the success of these jets. Once upon a time aeronautical progress was sabotaged for nearly a decade by CAA's insistence on the notorious "slope-line" approach lights. Are we now to witness a runway light repetition of this?

United Opposes American Nonstop Bid

By Robert H. Cook

Washington—Addition of a third nonstop carrier in the New York-San Francisco market may cause competitive losses sufficient to endanger the investment future of the entire airline industry, United Airlines charged, in opposing American Airlines' application for nonstop authority between the two cities.

A. M. de Voursney, vice president of United, told the Civil Aeronautics Board that such a "body blow" would result in a net income loss of $6.4 million by United and Trans World Airlines in 1960. De Voursney said present competition between the two carriers is expected to produce a net profit of $1.4 million for United and TWA, while the addition of American's competition would convert a net profit of $871,000 for United to a net loss of $1.6 million for this route segment.

Citing a forecast of United system earnings, de Voursney told the Board the airline's net earnings will drop to $2.1 million in 1960, rise to a $4.5 million peak by the following year and then decline to $2 million by 1963 with losses predicted for both 1964 and 1965. He said that the expected traffic growth by 1965 will not pull the New York-San Francisco route out of the red. He predicted an estimated $2.2 million segment loss for 1965 if American is allowed nonstop authority over the route.

United and TWA presently have nonstop authority in the New York-San Francisco market while American is forced to stop at Chicago. American contends that failure of the Civil Aeronautics Board to lift the restriction will virtually eliminate the carrier from the market since passengers will demand nonstop service with the appearance of jet aircraft.

If approved by the CAB in time, American's application would allow the carrier to begin the first nonstop jet service between the two cities by Jan. 31, witnesses for American testified.

Pointing out that United and Trans World carried 32% of the domestic traffic during 1957, de Voursney asked the CAB "if two of the largest carriers in the industry cannot rely on their regulated status to control excessive competition and preserve earning power what then is the investment future for the rest of the industry?"

The financial fortunes of the two carriers, he said, will do much to influence investors in airline securities.

In particular, United criticized American's prediction of a 10% annual traffic growth for the New York-San Francisco route in addition to an increase of 10 and 15%, respectively, in 1959 to allow for alleged traffic under-development and passenger appeal of the new jets.

None of the present carriers in American, expect to begin a full jet service pattern on the route for the entire year, de Voursney said, because of limitations on jet deliveries. Effect of the greater drawing power of jet aircraft is expected in 1960, he said.

Believing that business traffic will account for the major portion of any expected traffic gains, United estimated traffic stimulation attributable to jet service in 1960 at 12% as compared with American's estimate of a 25% increase in the 1960 traffic volume above the normal rate growth.

Noting a general decline in the traffic rate growth of the New York-San Francisco market during the past five years, de Voursney said that United has estimated a traffic growth averaging only 6% annually for the route. He added that traffic on this segment during the months of January, March, May and July was 8.68% less than during the same months of 1957.

The August volume was 7.1% less than that for the same month last year, indicating that total traffic on the route this year may be less than in 1957, de Voursney said.

In further objections to the approval of American's application, United mentioned the inauguration of polar routes between San Francisco and Europe by Pan American and TWA and bilateral agreements awarding San Francisco-New York routes to British Overseas Airways Corp. and Qantas Airways as additional traffic diversions.

During June, Pan American carried 2,159 passengers from San Francisco to Europe via the polar route while BOAC and Qantas carried 1,162 and 552 overseas passengers, respectively, on the transcontinental route. Data on TWA's polar route was not available, de Voursney said, but the three carriers listed accounted for 129 passengers daily, or the equivalent of more than one first class DC-7 roundtrip per day. De Voursney said expansion of this service can be expected to increase the diversion.

TWA 707 Transports Assembled

Nose sections of four Trans World Airlines 707 jet transports take shape at Renton, Wash., plant of Boeing Airplane Co. Two other TWA 707s are on the assembly line. First of eight Model 120 jets ordered by TWA are scheduled for delivery by the first of next year.

Trans-Canada Faces New Competition

Ottawa—Trans-Canada Air Lines will face the prospect of competition on its Canadian transcontinental routes for the first time when the Canadian Air Transport Board meets next week to begin a series of hearings on the need for a new air service.

First of the hearings will be held Monday in Vancouver and will be followed by hearings in Edmonton, Regina, Winnipeg and Moncton. Public hearings will begin here Oct. 20. Canadian Pacific Airlines, leading contender for any new routes that may be granted, is seeking transcontinental routes between Vancouver and Montreal as well as routes between Edmonton and Toronto and Winnipeg and Montreal.

SHORTLINES

► **American Airlines** reports a new monthly domestic airline industry record for air freight. The airline carried 9,418,000 ton miles of air freight during August as compared with the old record, also set by American during May, 1957, of 7,960,000 ton miles. The August figure is a 22.5% gain over the August 1957, figure.

► **Pan American World Airways** carried 6,441 westbound passengers across the Atlantic during the height of the late summer rush during the week ending Sept. 6. The airline says the total represents a 19% increase over the same westbound peak of 1957.

► **British West Indian Airways** plans to increase its Vickers Viscount service from New York to Trinidad from four to six flights weekly beginning Nov. 1. Stops will be made at Bermuda, Antigua and Barbados en route on Sunday, Wednesday and Friday; the Tuesday flight will stop at Bermuda, San Juan, Antigua and Barbados. All flights to Trinidad will depart New York International Airport at 10 a.m. EST.

► **LAV, the Venezuelan airline,** will install the Bendix RDX1B weather radar system, already installed in one LAV Lockheed Super Constellation, in six additional aircraft. Lockheed Aircraft Service-International, which maintains LAV's international fleet, will do the installation. The aircraft involved are used on LAV's U. S.-to-South America and Caracas-to-Europe routes.

► **Deutsche Lufthansa** will inaugurate service to Cairo on Nov. 1. The new route will connect with the carrier's daily service from New York to Frankfurt and will be routed via Munich, Istanbul and Damascus.

► **Northeast Airlines** was scheduled to increase its Vickers Viscount service in the Washington-New York-Boston areas last week. The airline planned to add two roundtrip flights from New York to Boston and three roundtrip flights from New York to Washington.

► **Northwest Airlines** says it will offer more than seven million passenger seat-miles per day during the coming winter months, an 11.2% increase over the comparable period last year. Northwest's winter schedules, which were to begin yesterday, will include daily flights from Seattle-Tacoma to Honolulu. Northwest also plans to retire all of its Douglas DC-3 aircraft now used on some local routes through Montana.

AIRLINE OBSERVER

► Chances are strong that the Civil Aeronautics Board will pave the way for a second fare increase this year by approving Continental Air Lines' "package" tariff revisions that were filed to become effective Oct. 1 (AW Sept. 22, p. 38). Continental's tariff filing is closely patterned after the fare differential rate structure recommended by Dr. Paul Cherington in his report to Presidential Aide Elwood Quesada. Since the report has strong White House backing, its recommendations are not likely to be ignored by the Board. Basically, the Continental tariff calls for a 6% increase in first-class and basic coach fares, a 20% reduction in "experimental" coach fares, extension of the family plan and winter excursions for family groups—a clearly detailed outline of Cherington's broad-brush proposals.

► Bristol 205 is being billed by the manufacturer as a Viscount-Convair replacement. Plane is to be built around four Bristol Orpheus turbojet engines and will have a 58-passenger capacity. Design cruise speed is 560 mph. and design gross weight is 70,000 lb.

► British Overseas Airways is expressing some doubts over the economic value of its routes from London to Warsaw and to Moscow. In its annual report the company says: "Such routes are not without their commercial and financial problems and, like all other routes, will have to be justified by future results."

► Spanish government is remaining noncommittal on routes awarded to Pan American by the Civil Aeronautics Board from New York to Johannesburg via Madrid and to Madrid from Puerto Rico. Talks between Spain and the U. S. last winter ended in a stalemate because of Spain's stand that at present the bilateral agreement between the two countries does not permit the Pan American routing. No attempt has been made to reopen discussions on the subject.

► Fairchild Engine and Airplane Corp. has hiked the price of its F-27 transports powered with Rolls Royce R.Da.6 engines from $590,000 to $635,000. F-27s equipped with the R.Da.7 engines will be priced at $695,000, an increase of $35,000. Fairchild's order for the F-27 total 95 (AW Sept. 15, p. 89).

► Independent Airlines Assn. is asking Civil Aeronautics Board to investigate the "low bids" by Trans World Airlines and Pan American World Airways to carry Military Air Transport Service traffic. MATS has awarded contracts totaling $24 million for airlifts to Europe and the Far East with TWA winning $11.9 million and Pan American $11.9 million. Transocean Air Lines and Slick Airways also received contracts. TWA last week said it would operate more than 1,600 charter flights during the next year and carry more than 121,000 personnel under the contract.

► Some economists are saying it is still too early to measure the full effect of the economic recession on airline traffic and add that the rate of recovery of passenger revenue miles during the next few months will help determine how much of 1958's traffic slump can be attributed to the recession. Most surveys indicate that the rate of air travel growth is declining and suggest that the recession accelerated this trend. One study shows that traffic carried by public carriers as a group is falling behind the private automobile which now accounts for 90% of all intercity traffic, but points out that air travel is still the fastest growing segment within the transportation field. This study finds air travel is more related to the increase of the gross national product than it is to population growth and cautiously concludes that air travel per capita will not stabilize until the growth of the gross national product slows down and falls in line with population growth.

► Northeast Airlines has backed its bid to extend its Florida service to Fort Lauderdale as a Miami co-terminal with a proposal to serve the route with Viscounts. The turboprops are presently confined to the Boston-New York-Washington segment of its routes.

Airline Income & Expenses—July, 1958

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Express	Freight	Charter	Total Operating Revenue	Total Operating Expenses	Net Income (Before Taxes)
DOMESTIC TRUNK								
Amerisan	24,543,677	565,515	2,212,025†		165,907	27,611,717	24,481,454	3,471,534
Braniff	4,448,933	127,429	55,319	153,267	7,623	4,869,186	4,592,304	222,173
Capital	7,855,670	187,635	103,194	116,418	16,642	8,407,228	8,332,249	−229,340
Continental	2,757,360	45,000	18,000	52,000	2,000	2,933,250	2,713,053	52,757
Delta	6,055,043	154,672	80,242	260,174		6,747,855	6,594,659	110,592
Eastern	18,445,619	311,133	735,817†		18,882	19,601,827	19,358,185	268,342
National	3,489,228	79,763	14,561	123,191	58,240	3,943,021	4,195,930	−308,206
Northeast	1,927,686	25,451	6,423	37,660		2,031,442	2,427,281	−463,219
Northwest	5,695,896	160,874	373,941†		27,948	6,279,788	5,504,198	775,189§
Trans World	18,052,847	389,051	889,978†		47,874	19,456,257	18,424,563	822,653
United	24,455,417	756,136	1,769,723†		189,552	27,312,064	23,996,326	3,070,287
Western	3,532,497	73,478	33,079	61,832	30,176	3,768,141	3,418,428	289,716
INTERNATIONAL								
Amerisan	528,990	3,139	69,444†			620,788	555,169	63,904
Braniff	584,871	7,715		38,577		676,586	698,560	−21,930
Caribbean-Atlantis	190,313	1,935	5,819†		3,209	208,779	172,132	36,682
Delta	423,383	5,125		11,664		462,851	468,675	−2,667
Eastern	2,413,633	36,869	75,334†		77,388	2,623,887	2,118,179	497,857
Muskey	138,378			1,847		144,195	141,707	3,212
National	387,562	3,330	1,989	11,473	1,368	416,301	325,547	87,697
Northwest	2,232,281	518,314	306,678†		295,242	3,442,984	2,358,890	1,084,894§
Pan American								
Alaska	340,000	14,000	33,000†		30,000	430,000	455,000	−25,000
Atlantis	12,757,000	615,000	1,158,000†		389,000	15,149,000	13,317,890	1,757,000
Latin America	6,295,000	180,000	1,289,000†		86,000	7,882,000	8,060,000	590,000
Pacific	4,918,000	499,000	836,000†		656,000	7,149,000	6,054,000	1,103,000
Panagra	1,078,000	47,000		167,000	38,000	1,539,000	1,594,000	−31,000
Resort						503,407	463,366	47,621
Trans Caribbean*								
Trans World	7,253,900	541,793	412,332†		686,611	9,180,270	8,269,213	657,888
UMCA	6,101		1,015†			7,127	9,329	−2,202
United	1,575,214	53,468	35,345†			1,672,337	1,198,284	463,444
Western	85,848	1,221		646		89,633	149,831	−53,220
LOCAL SERVICE								
Allegheny	581,470	10,388	9,414	12,353		823,997	815,534	1,907
Bonanza	213,206	3,121	1,673	7,231	1,620	367,602	392,368	−24,571
Central	160,408	6,751	1,266	4,783	5,729	391,982	417,149	−26,427
Frontier	325,273	327,606*	3,000	22,409	5,905	693,371	625,012	88,049
Lake Central	155,150	4,551	6,688†		120	316,924	312,295	3,715
Mohawk	519,666	6,702	10,701	8,454	17,412	694,094	759,976	−139,506
North Central	829,901	858,112*	12,824			1,748,186	1,137,212	807,185
Ozark	428,876	233,646*	6,911	10,738	212	686,805	655,088	27,426
Pacific*								
Piedmont	539,302	10,252	5,033	7,378		826,083	753,643	63,504
Southern	233,043	7,488	3,049	5,389	63	489,902	398,058	9,867
Trans-Texas	307,360	10,560	2,926	12,416	5,369	596,148	583,924	11,894
West Coast	250,473	3,824	1,760	5,006	711	486,743	424,218	−19,369
HAWAIIAN								
Hawaiian	548,771	3,513		67,756		924,259	746,564	157,068
Trans-Pacific	249,681	590		7,493		282,792	243,784	33,668
CARGO LINES								
AAXICO		2,635	2,250	50,734	493,297	576,748	616,521	−39,781
Aerovias Sud Americana			129,018‡		17,919	149,022	151,834	21,887
Flying Tiger		8,034	864,453†		2,545,093	3,406,121	2,823,973	558,408
Riddle*								
Seaboard & Western						2,784,428	2,186,304	578,322
Slick					814,705	1,012,273	817,688	149,584
HELICOPTER LINES								
Chicago Helicopter	56,333	104,901*				163,323	163,286	−4,627
Los Angeles Airways	17,302	10,464	9,493		516	117,844	99,073	20,621
New York Airways	63,828	3,702	1,333	2,074		288,779	733,713	28,281
ALASKA LINES								
Alaska Airlines	215,808	47,141	597	50,028	118,355	587,652	539,336	42,824
Alaska Coastal	95,873	9,105		10,302	13,701	165,690	138,136	27,580
Cordova	10,010	7,938		4,364	18,369	76,117	83,089	−9,111
Ellis	67,646	4,348	7,220		10,293	113,651	78,250	29,872
Northern Consolidated	87,818	30,181		42,048		244,339	216,587	26,003
Pacific Northern	831,384	64,797	90,899†		15,830	1,149,690	904,442	235,243
Reeve Aleutian*								
Wien Alaska	153,412	42,249		31,592	154,039	472,585	428,214	47,054

* Not available † Property Figure ‡ Listed as "Common Carriage § Net operating income • Includes Federal Subsidy

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board

FIRE FIGHTING S-58—Approaching a blazing gasoline fire, a Sikorsky S-58 delivers aerial fire fighting rig and personnel in a demonstration of the helicopter's capabilities in fighting fires, especially those hard to reach by ground transport. Downwash from rotor blades helps suppress or extinguish fire and protects firemen from intense heat. This unit, carrying 250 gallons of foam, was designed by American LaFrance in cooperation with Sikorsky Aircraft.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS

CHOPPER JOHN—Twin-engined Army H-37s (Sikorsky S-56s) airlifted Honest John missiles, launchers, and crews at Project AMMO, a missile demonstration at White Sands, New Mexico, and Fort Bliss, Texas, to show how helicopters provide mobility for Army missiles under combat conditions. Other Sikorskys flying at Project AMMO were H-34s (S-58s) and H-19s (S-55s).

DEEP FREEZE III—In the Antarctic, large Sikorsky S-58s have joined the S-55s widely used for the past three years in U. S. activities supporting the International Geophysical Year. Their duties include passenger and cargo transport, reconnaissance, and search and rescue. The version of the S-58 shown above, the Navy HUS-1A utility configuration, is transporting cargo in Little America.

LOOK, NO HANDS!—Now certificated by the CAA for commercial use, Sikorsky Aircraft's advanced ASE (automatic stabilization equipment) is a combined stability augmentation device and autopilot. Relieving the helicopter pilot of the need for constant flight control adjustments, ASE has been proved in more than 100,000 hours of flight in over 350 Navy and Marine Corps versions of the S-58 and S-56 helicopters. This equipment enables Sikorsky helicopters to fly with unmatched precision and stability—vital abilities in many military and civilian tasks. And coupled with other equipment, it facilitates helicopter flight under instrument conditions.

Automatic stabilization equipment is another example of Sikorsky Aircraft's engineering and production leadership in the helicopter field.

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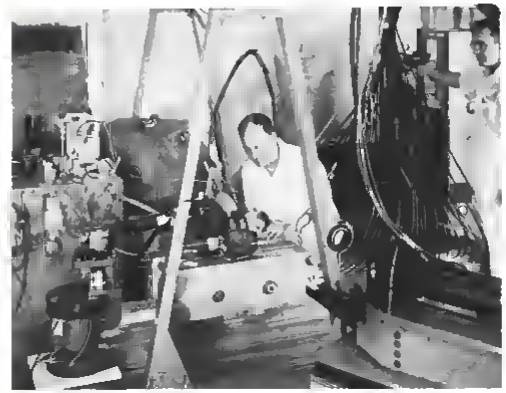
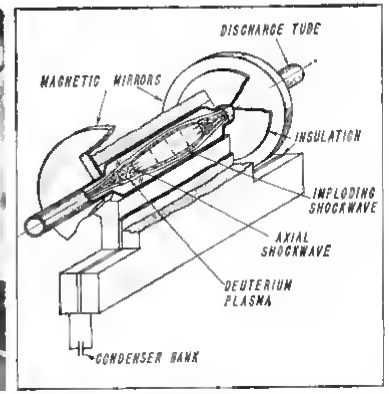




THERMONUCLEAR power machine at Naval Research Laboratory (left) uses very powerful electric discharge to create shock waves which raise temperature of deuterium plasma. Shock wave in combination with magnetic fields (right) keeps plasma from container walls

Fusion Power Progress Noted at Geneva

By Philip J. Klass

Washington—Modestly encouraging progress toward understanding and solving basic problems involved in thermonuclear (controlled fusion) generation of power was reported in Geneva by scientists at the Second United Nations International Conference on Peaceful Uses of Atomic Energy.

Assessment of progress toward controlled fusion is greatly complicated by difficulty of measuring and diagnosing what is taking place inside hot plasma in the few millionths of a second during which reaction lasts, particularly since plasma is inhomogeneous and varies rapidly with time (AW May 12, p. 48).

Production of neutrons, one indication that a thermonuclear reaction is taking place, can also result from plasma touching container walls and producing "false neutrons." Difficulty of establishing source of neutrons has previously misled some scientists, making them all extremely cautious at present.

For example, U.S. scientists from the Atomic Energy Commission's Los Alamos Laboratory reported that an experimental device called Scylla had produced neutrons whose "thermonuclear origin appears plausible," but said further tests will be required to confirm or deny findings.

A considerable number of papers dealing with diagnostic techniques and instrumentation indicated that sizable effort is going into development of better methods for analyzing what is taking place inside experimental thermonuclear equipments.

Of the approximately 80 papers on controlled fusion included at the conference, more than 50 were presented by U.S. scientists. There were 10 papers on controlled fusion by Soviet scientists, eight from Great Britain, five from Sweden and two from Japan.

Number of different techniques were described for attempting to solve the two most basic and difficult problems involved in controlled fusion power generation:

- **Raising plasma temperature** to the required 30 to 300 million degrees Kelvin.
- **Confining and stabilizing** plasma to prevent contamination and/or loss of heat due to contact with container walls.

Third Approach

Majority of thermonuclear projects reported seek to confine the plasma first and then heat it, or to confine and heat it simultaneously. Professor H. O. G. Alfven of Sweden suggested a third possibility—heating plasma first and then confining it—which looks attractive and may not be as difficult as previously thought. He reported that Sweden is experimenting with initially heating plasma, then shooting it into a magnetic field in an effort to capture and confine it.

Several comparatively new ideas for simultaneously heating and confining plasma were reported.

- **Magnetically driven** shock waves, used to raise plasma temperature, in combination with other magnetic fields which produce plasma confinement, was a technique reported by Dr. A. C. Kolb of U.S. Naval Research Laboratory. Tests indicate the technique has produced deuterium plasma temperature greater than three million degrees and possibly as high as 10 million degrees. Dr. Kolb reported. Difficult measurements are now underway to establish the temperature actually achieved.

Shock waves are produced by a 15 million ampere discharge which takes place at one or both ends of a quartz tube containing the plasma. Magnetic fields directly along the tube's axis compress the plasma, raising its temperature still higher and producing radially imploding shock waves. Magnetic mirrors at both ends of the tube create higher magnetic pressures at the ends than at the center, producing a form of "magnetic bottle" which prevents hot gases from rapidly escaping from high temperature region.

- **Astron project** which will use a cylinder of rotating relativistic electrons (moving at speed approaching that of light) to surround plasma. Cylinder of relativistic electrons is expected to create a magnetic field which will confine plasma, provide initial ionization and heat it to ignition temperatures, according to N. C. Christofilos of University of California Radiation Laboratory at Livermore. Electron gun with energy of several million electron volts will shoot the beam into a vacuum

chamber containing the deuterium gas. First model is now under construction.

(Christofilos, an American born electrical engineer who spent most of his life in Greece, first proposed the Astron concept to the Atomic Energy Commission in 1953. His letters were initially dismissed as the work of a "crank," because theories did not appear valid. AEC subsequently changed its mind, brought Christofilos over to the U. S. and in 1957 authorized construction of an experimental machine to prove or disprove the feasibility of this approach.)

Early attempts to achieve thermonuclear reaction sought to use a simple technique both to confine plasma and heat it. Electric current passed through the plasma produces a magnetic field ("bottle") which squeezes the plasma into a smaller diameter, producing an increase in plasma temperature and providing magnetic enclosure to keep plasma from touching container walls.

An inherent problem with this approach is that the uniformity of pressure exerted by the magnetic bottle along the plasma depends upon the uniformity of the plasma itself which in turn depends upon the uniformity of the magnetic field pressure.

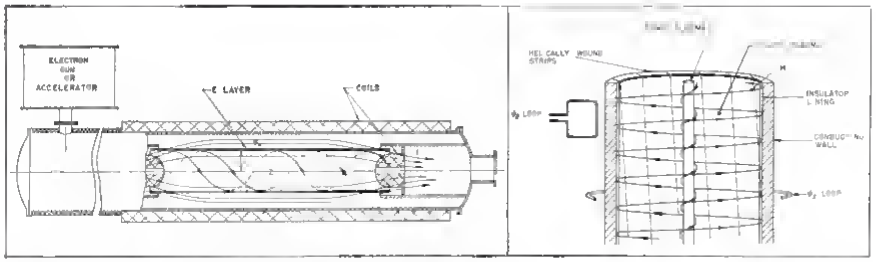
As plasma diameter is pinched down it exerts greater pressure against the applied magnetic field. Finally a point is reached where weakness in one or more parts of the magnetic bottle, due to inhomogeneities in the plasma itself, causes the plasma to break through and destroy the magnetic containment.

One of the attractive features of the Astron approach is that the magnetic bottle is produced by relativistic electron beams and not by the plasma itself. Japanese scientists from University of Tokyo also reported that experiments are planned to investigate the technique.

Improved Pinch

Number of techniques for improving the stability of the magnetic pinch effect, used to heat and contain the plasma, were discussed at Geneva.

• **Homopolar (rotating) plasma.** Theory suggests that a long lived thermonuclear plasma can be achieved if plasma is in rapid rotation. University of California Radiation Laboratory scientists reported. In one experimental machine a radial electric field and an axial magnetic field are used to set plasma into azimuthal drift motion. A transient radial current flows during the acceleration stage which can serve to pinch the plasma axially away from insulating end plates. Axial containment is achieved at first by the azimuthal pinch field and later by the centrifugal trapping effect. The plasma containment is promising but adequacy of self-heating is in some doubt. Rotational kinetic energy can



ASTRON thermonuclear machine (left) uses sheath of extremely high speed electrons to both heat plasma and provide containment Screw dynamic pinch (right) employs helical conductor shield to stabilize hot plasma

be converted to plasma heating by viscosity or turbulent mixing but auxiliary heating may be required to achieve thermonuclear reaction temperatures

• **Screw dynamic pinch** Another pinch stabilizing technique under investigation at University of California Radiation Laboratory is the use of a conducting sheath surrounding the plasma, but insulated from it, to provide the stabilizing axial field intended to reinforce the plasma and prevent it from buckling The external conductor is formed from individual pieces which are given a slight helical twist to produce a stabilizing field which moves as if traveling around the threads of a screw

Whether plasma heating is achieved by the pinch effect or other means some form of magnetic container is required to keep it from contacting external container walls Several ideas for improved magnetic containment discussed at Geneva include

• **Guarding conductors.** Use of metal conducting rods, placed like a picket fence around the plasma (inside a quartz container), can produce a non uniform magnetic field which serves to stabilize the plasma, two Soviet scientists reported For toroidal shaped thermonuclear machines series of conducting rings performs the same function Important advantage of guarding conductors in toroidal-shaped thermonuclear machines, the Russian scientists said, is to provide continuous magnetic containment when the plasma current goes to zero, so that azimuthal symmetry of the plasma will be preserved Soviet scientists predicted "great future" for use of guarding conductors in combination with pinch effect

• **Induction pinch** Instead of passing current from external source through plasma to generate constraining magnetic field and pinch which produces plasma heating Japanese scientists propose to produce magnetic field by external winding, let the magnetic field induce currents in the plasma which will create heating

• **Divertor** This device, described by scientists from Princeton University's Project Matterhorn reduces the amount of plasma that escapes magnetic containment and knocks impurities off external container walls Divertor has reduced plasma impurity concentration in B-65 Stellerator by factor of two or three to one should do considerably better with refinements scientists reported Divertor provides a cylindrical shell of magnetic flux which hot ions diffusing radially outward from the main plasma follow into an auxiliary chamber and collector plate instead of hitting walls of main discharge tube

Radio Frequency Machines

Thermonuclear machines which use periodic magnetic or electromagnetic fields produced by radio frequencies excitation to provide principal plasma confining force were discussed by scientists of U S Argonne National Laboratory Use of RF energy to create plasma containment provides a larger variety of field configurations than obtainable with plasma induction currents Also the periodic nature of RF fields offers opportunity to take advantage of dynamic stabilization effects within the plasma itself which is not possible when plasma generates its own containment

Equally important use of suitable RF fields may simultaneously perform functions of plasma confinement, heating and direct electrical power extraction without auxiliary devices Range of use

Sputnik III Nose Cone Path

Intermittent streak produced by Delta I (Sputnik III nose cone) is due to its tumbling through space Path of the nose cone is through Hercules constellation in this photo Time elapsed between flashes is about 11 sec

ful RF frequencies is between 10 and 1,000 mc.

Use of oscillating electromagnetic fields to heat a confined plasma also was discussed by Project Matterhorn scientists from Princeton.

Oak Ridge National Laboratory scientists reported another approach to the problem of raising plasma temperature to the point where reaction is self-maintaining—called ignition point. Oak Ridge is injecting deuterium molecular ions at an energy level of 600,000 electron volts into a direct current mirror machine, known as DCX. The stream of molecular ions passes through a special arc discharge which produces dissociation into atomic and neutral atoms. The neutral and any un-dissociated ions are separated from the atomic ions because they have different radius of curvature and exit from the machine immediately, leaving the atomic ions in the form of a highly organizing beam. The ions of this beam cause ionization of the residual gas in the machine and the whole plasma temperature is raised by interaction with electrons and other ions.

Scientists emphasized that the present DCX machine will not allow creation of a self-sustaining plasma because reaction products are so energetic that they reach container walls. One way to avoid this difficulty is to compress the plasma after it has been formed; use this for dissociation of molecular ions and heating. This would eliminate the special arc discharge after initial plasma has been formed, permit use of cold neutral ions and make it easier to contain the reaction.

Situation Reversed

In contrast to the comparative optimism of some British scientists a year ago that successful thermonuclear power was near at hand, United Kingdom representatives appear more bearish than their American counterparts at the moment. R. J. Taylor of Britain's Atomic Energy Authority Harwell Laboratory says: "the problem of gas discharge stability is still in its early stages and much remains to be done." P. C. Thonemann, also of Harwell, points out that currents of about 10 million amperes will be required for at least 0.1 sec. duration in a tritium-deuterium mixture before a net balance of power is achieved using self-magnetic confinement in a tube of reasonable dimensions. "Such current amplitudes clearly present difficult technological problems," Thonemann said. He added that the question of whether thermonuclear power generation is possible should be answered within the next decade, but another 10 years might be required to determine whether such a power source is economically valuable if it proves possible.

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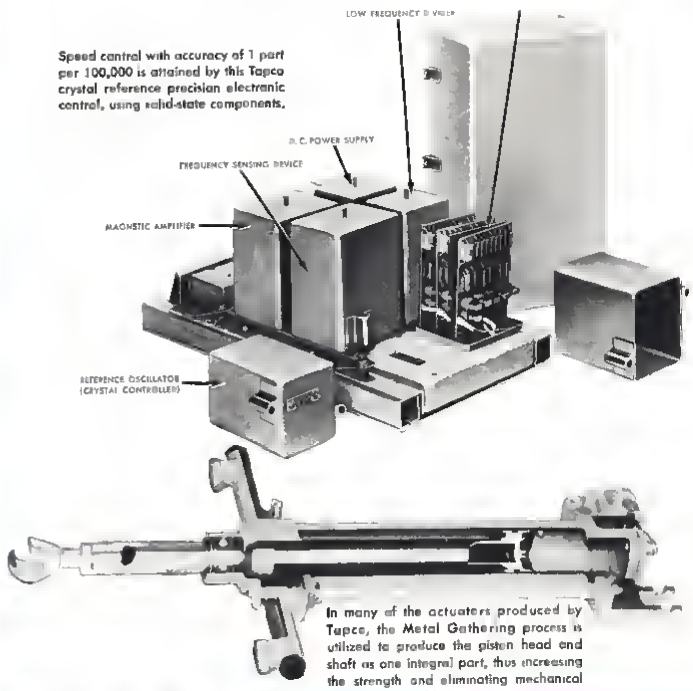
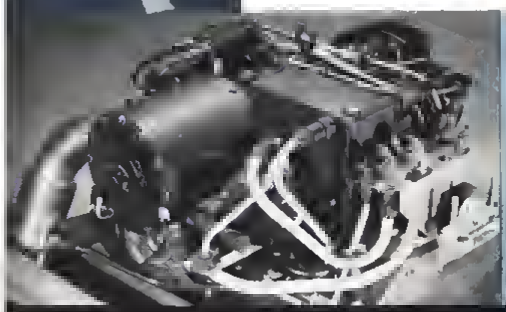
Designed for ground check-out of internal guidance gyros on an intercontinental missile, this Tapco servo-controlled missile Ground Test Unit weighs only 650 lbs.

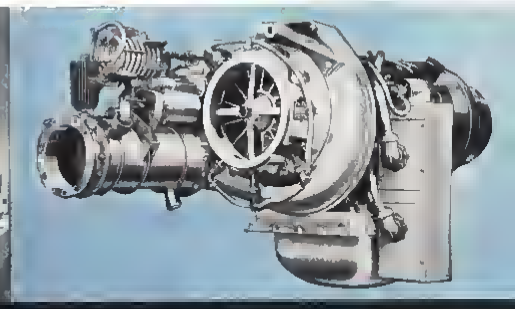


Speed control with accuracy of 1 part per 100,000 is attained by this Tapco crystal reference precision electronic control, using solid-state components.

In many of the actuators produced by Tapco, the Metal Gathering process is utilized to produce the piston head and shaft as one integral part, thus increasing the strength and eliminating mechanical fastening or welding.



Tapco-designed controls are used on auxiliary power units for the precise metering of hydraulic and electrical energy.



This Tapco designed and volume produced 60 kva air turbine alternator drive includes a Tapco control system which holds 400 cycle current generation to ± 25% in parallel or isolated operation.

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Blackburn NA.39 strike aircraft made high-speed, low level turns at Farnborough (AW Sept. 8, p. 26). Sea level speed approaches Mach 1

British Navy Demonstrates NA.39 Low-Level Bomber

Speed brake counteracts thrust generated by de Havilland Gyron Junior turbojets (7,000 lb. thrust each) as power is applied to supply bleed air for flap boundary layer control

Main landing gear retracts inward, nosewheel retracts rearward. NA.39 is designed to carry nuclear stores in internal weapons bay

USAF Developing High Temperature Oils

By Michael Yaffee

New York—Air Force expects to qualify the first 400F oils for advanced turbojet engines, within two months. Five hundred degree oils will follow, possibly within two years, with the ultimate goal being a radiation-resistant lubricant that will perform satisfactorily at 1,000F.

The new 400F lubricants are specifically designed to meet the lubricity and cooling requirements of the advanced turbine engines now under development such as the General Electric J93 which will not be able to operate with the currently available lubricants. At the same time, however, the new oils are expected to benefit significantly the operation of some of the newer jet engines already in use such as the Pratt & Whitney J75, General Electric J79 and even the Pratt & Whitney J57.

At present, researchers at the propulsion laboratory of Wright Air Development Center are evaluating 13 new oils submitted by petroleum and chemical companies for qualification under target specification Mil-L-9236A (USAF). Two of these have now passed most of the provisional tests and if they pass the remaining ones, will probably be used as the basis for the final production version of specification Mil-L-9236A.

Like the lubricants produced under the preceding specification Mil-L-7808, the 9236A oils will be synthetics. The first one to be accepted under the new specification will probably be either a high molecular weight ester or a mixture of complex esters combined with corrosion and foam inhibitors. Other possibilities are a chloro-phenyl silicone, a polyglycol plus additives, a methyl phenyl silicone, and a high molecular weight sebacate plus additive.

Principally, the Air Force is looking for an all-around lubricant with improved high temperature and oxidative stability and high load-carrying capacity. The new lubricants will be expected to perform satisfactorily at a bulk oil temperature of 400F.

This is the anticipated "oil-in" temperature (i.e., the temperature of the oil as it passes from the oil tank into the engine). In the engine the oil will encounter bearing temperatures up to 500F or higher. And as the oil continues through the engine the temperature gets hotter.

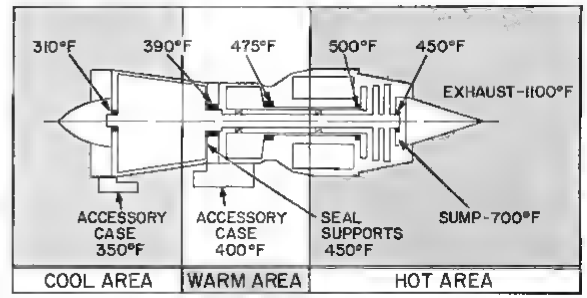
In the area of the No. 6 rear sump of the J57 oil test engine used at the WADC propulsion laboratory, temperatures average 700F and have reached 800F, according to Kerry L. Berkey, senior project engineer.

Oil out temperatures run from 425 to 445F. (This is accumulated temperature of the return oil from all engine areas.)

In regard to oxidation resistance, test specification Mil-L-9236A requires that the viscosity of the lubricant after exposure to a temperature of 500F for 48 hr. shall not change more than −5 to +300% (raised from the +25% called for in an earlier version of the specification) from the original centistoke viscosity at 100F. Minimum load-carrying ability, initially set at 2,800 lb. per in. of tooth face width when tested in the Ryder gear testing machine at 10,000 rpm. and 165F oil inlet temperature, has currently been powered to 2,200 ppi.

Among the other characteristics that will be required in the new lubricants are the following:

- **Low coking.** When heated to 700F, the lubricant should not deposit more than 100 mg. of coke. There is often the danger that coke and sludge deposits will form when lubricants, particularly hydrocarbons, are heated to high temperatures in the presence of oxygen. These deposits block oil lines and gum up bearings.
- **Low volatility.** Initial specification called for an evaporation loss not to exceed 5% when the lubricant is heated to 400F for 6½ hr. This limit has been raised and no definite ceiling has been established.
- **Non-corrosiveness.** The lubricant must be practically noncorrosive to structural materials used in turbine engines. Mil-L-9236A states that the change in weight of steel, titanium, aluminum alloy and silver shall be not greater than ±0.2 mg. per cm.² and copper not greater than ±0.4 mg. per cm.² when subjected to the lubricant for 48 hr. at 500F.
- **Low foaming.** Foaming leads to slugging or entrainment losses. To date,



WRIGHT Air Development Center schematic shows a Pratt & Whitney J57 turbojet engine which is used to evaluate new turbine lubricants. Black squares represent bearings.

Turbojet Engine Temperatures

The trend of gas turbine operating temperatures is sharply upward. Following are maximum temperatures that lubrication engineers now have to contend with and minimum temperatures they expect to encounter in the indefinite future.

	PRESENT (F)	FUTURE (F)
Bearings	375	800
Gears	250	600
Hot spots	800	1,000
Bulk oil	250	600
Heat rejection rate (Btu/min.)	3,000	7,000

Nuclear Lubricant Developed

Cincinnati—Base stocks for hydraulic fluids and lubricants for aircraft nuclear propulsion systems have been developed by General Electric Co. chemists according to D. R. Shoults, general manager of the company's Aircraft Nuclear Propulsion Department. Metapolyphenyl ether fluids could have applications in rockets and space vehicles, wherever temperature and radiation is critical, Shoults said. Materials also have promise as liquid insulation or dielectric liquids in electrical apparatus, he added. New fluids were developed under Atomic Energy Commission and U. S. Air Force contract at General Electric's General Engineering Laboratory, Schenectady, N. Y.

this has been a principal drawback to the silicone oils under evaluation at WADC.

There are a number of other lubricant requirements—some already established and others still contemplated—which will show up in the production version of Mil-L-9236A. But noticeably absent at this point are set low temperature kinematic viscosity and pour point.

Owing to the global operation of its aircraft, the Air Force has heretofore considered low temperature fluidity a prime requisite of engine lubricants. Previous specifications required lubricants to have a maximum pour point no higher than −75F and a maximum viscosity of 13,000 centistokes at −65F. Mil-L-9236A says only that the limiting low temperature of the oil shall be reported and is defined as that temperature at which the oil has a viscosity of 13,000 centistokes. Thus, while low temperature fluidity is still desired and important, it is now considered secondary to high temperature operability and may have to be sacrificed to some degree, at least for the latter.

Hydrocarbons Out

Early turbojet engines, like the piston engines, operated satisfactorily with natural hydrocarbon lubricants. These first gas turbines—still powering aircraft such as the Lockheed T-33, North American F-86, Northrop F-89, Lockheed F-94 and Boeing B-47—were designed to operate at bulk oil temperatures of 125 to 150F and offered no unusually difficult lubrication problem. The lubricants used in these engines are light mineral (hydrocarbon) oils, they are covered by specification Mil-L-6081, and they sell for about 50 cents per gal.

With the development of more advanced gas turbine engines such as the J57, Curtiss-Wright J65, J75 and J79—powerplants for aircraft such as the Boeing B-52, Martin B-57, Convair B-58, North American F-100, McDonnell F-101, Convair F-102 and F-106—lubrication problems became much more severe. Oil-in temperatures jumped 100 deg. to 225-250F; bearing temperatures rose more than 150 deg. from 300F; unit loads on gears and bearings increased; heat rejection rates to the oil went up accordingly; and the formerly successful use of air to cool the lubricant itself no longer worked once flight speeds passed Mach 1.

Petroleum based lubricants no longer could handle the job. Used in the newer engines, the light mineral oils showed heavy coke and sludge formation and marginal load-carrying ability and were excessively consumed. The higher viscosity mineral oils possessed better load-carrying ability but had poor low temperature characteristics and formed heavy sludge deposits.

To meet the more severe lubricating requirements of the newer gas turbine engine, the oil people had to turn to an all-synthetic product. The result was a number of synthetic oils consisting of a chemically derived dioctyl diester combined with suitable additives.

Air Force researchers meanwhile, developed specifications for the new synthetic lubricants and these were formally compiled as Mil-L-7808. Since 1954 WADC has evaluated about 80 oils for qualification under Mil-L-7808. Of these, 21 reached engine testing but only nine successfully passed the engine test and were qualified.

In comparison with the mineral oils, WADC's Berkey says, the 7808 oils have better viscosity characteristics with respect to temperature changes, thus permitting equivalent low temperature and better high temperature operation. In operation, this meant that the new lubricants could perform satisfactorily at bulk oil temperatures as high as 250F without sacrificing the required −65F engine starting characteristic.

Because the 7808 oils are synthetics, their price, of course, is considerably higher than that of the mineral oils, running about $3.80 per gal or about seven to eight times as much. At the same time, however, consumption of the 7808 oils in an advanced jet engine, according to W. W. Gleason of Esso Standard Oil, is only about 1/50th that of the light mineral oils.

The biggest headache with the 7808 oils has been storage instability, says Berkey. WADC is now working on anti-deterioration additives and reports that preliminary results look promising. Bearing fatigue may prove a problem and the Air Force has studies under way to determine what can be done with the lubricant to ease this problem.

Also, load-carrying ability of the 7808 oils has proven borderline for some

turboprop engines due to the high speed propeller reduction gear assemblies which must be lubricated. To meet this condition, WADC has developed a new specification, Mil-L-25336, which raises the 1,700 ppi load-carrying minimum of the 7808 specification to 2,800 ppi. At least one new oil has already been qualified under 25336.

On the whole, the 7808 oils have given satisfactory service to date. Berkey declares and will probably be around for quite awhile. Even now, as the 7808 oils rapidly approach obsolescence in high-performance military aircraft, their future in passenger and cargo carrying jets appears impressive with the civilian market only now beginning to open up.

Civilian Impact

At present, the total market for synthetic aircraft lubricants is pegged at 2½ to 3 million gal. per year. The Air Force takes about ¾ or 1½ million gal. of this. It is estimated that in five years the total market for synthetic lubricants will approximately double, with civilian jet transports accounting for the major part of the increase.

Most of this new demand is expected to be for 7808 type oils, at least during the first few years. Commercial jet operators, of course, are not bound by military specifications. But the first U. S.-operated commercial jet aircraft—Boeing 707, Douglas DC-8 and Convair 880—in general will use unaltered versions of the J57, J75 and J79 engines developed for the military.

Consequently, commercial jet lubricant requirements are expected to be almost identical to those of the military with one important exception: commercial jets will not have to fly under the severe climatic extremes military aircraft must face.

Among other things, this means that commercial jets will not require lubricants with —65° engine starting capabilities and may be able to use higher viscosity ester-based lubricants like those developed and used in England.

Use of the British D. Eng. RD 2487 synthetic turbine lubricants (whose low temperature viscosities are approximately eight times higher than those of the 7808 oils) in routine airline service according to Esso's W. W. Gleason has resulted in light engine deposits, lack of gear scuffing, low wear, no metal corrosion and generally satisfactory performance.

In regard to economy, the 7808 type synthetic lubricants appear quite promising, despite their higher price compared with the natural mineral oils. Compilations based on extensive data from operation of the turboprop Viscount indicate that commercial consumption of synthetic lubricants amounts to approximately 500 gal. per year per aircraft. Although not strictly comparable, this does serve to some degree as an index of what can be ex-

Anti-Collision Light

Atkins-Honeywell anti-collision light, shown mounted on Air Defense Command Convair C-131, has received favorable comment from observers. High intensity lights, flashing at 1/1,000 sec. intervals, flash 160 times per minute to the front, 80 flashes to the side and 40 flashes to the rear. Observers report that even in bright sunlight, flashes can be seen twice as far as the aircraft itself. Light was developed by Minneapolis-Honeywell.

B-58 Hustler Completes First Midair Refueling

First midair refueling of Convair B-58 Hustler jet bomber utilizes Boeing KC-135 aerial tanker, somewhere over Texas. Convair's chief test pilot at Ft. Worth, B. A. Erickson, said he made two passes before accomplishing the hookup. Aerial refueling capability gives Hustler greatly extended range to combine with its 1,300 mph. plus speed. Air Force officials said

peeted in the commercial operation of straight American turbojet aircraft on American lubricants. Today's large piston engine aircraft consume approximately 12,000 gal. per year per aircraft of high viscosity mineral oils.

Lubricant producers, however, are not as interested in an individual turbine-piston comparison as they are in the projected, five year, 100% increase in the total demand for synthetic aircraft turbine oils. Chemical companies particularly, which in the past have been content to leave the aircraft lubricant market to the petroleum firms supplying only small amounts of additives when requested, are now taking an active interest in the field. Firms such as Union Carbide Corp., Hercules Powder Co., Rohm & Haas Co., and Monsanto Chemical Co. are working on the development of new lubricants and submitting them to the Air Force for evaluation. (In the event that any of these should be accepted, there is still the possibility, of course, that the chemical companies will decide not to sell directly to the aircraft operator, preferring instead to supply intermediate or finished materials to the petroleum companies which have already established extensive marketing and servicing organizations.)

Mach 2.4 and More

Although the latest generation of turbojet engines such as the J75 and J79 can operate on the 7808 oils Berkey says, most of them may be switched to more advanced lubricants when such become available. The next generation of gas turbine engines he declares, will absolutely require the new 400F oils.

Besides a notable rise in required heat rejection rates, the next generation of engines will be subject to a significant increase in ram air temperature. This rise in ram air temperature which is barely noticeable at Mach 1 and becomes only 200F at Mach 2, curves sharply upward to 400F at Mach 2.4. At this point 7808 oils are scarcely serviceable and at higher Mach numbers they drop completely out of the picture.

While it will probably be another seven years or more before commercial operators have to start worrying about lubricating Mach 3 jet transport engines, WADC's propulsion laboratory has to face up to the problem now. General Electric's J93 turbojet engine, potential powerplant for the North American B-70 and F-108, is already under development and is expected to be in the air in 1960. (AW July 14, p. 27)

As far as commercial development goes, the future 9236A oils like the 7808 oils before them and the more advanced lubricants that are certain to follow them for some time will almost all be chemically derived synthetic compounds and so will not seriously alter the general market development recently forecast for these compounds, except in regard to prices.

Many lubricant people believe that as a result of increased raw material, development and production costs, the prices of finished lubricants will rise significantly with each succeeding generation. Prices of the future 9236A oils, for example, are expected to be about three times higher than those of the 7808 oils. (Attempts to simulate the properties of the synthetics using cheaper petroleum stocks have been unsuccessful so far.)

Hydrocarbons Came Back

No one is sure just how long 9236A oils will last once they appear or what their successors will be like. But both government and industry researchers are already working far into the future covering broad areas of possible mechanical lubrication requirements and combing through a wide chemical range for compounds to fill these requirements.

All that appears certain at this point is that continuously rising operating temperatures and radiation will be the two biggest barriers future lubricants will have to surmount. And it is more than likely that these two problems will eventually become inseparable in most cases.

Research sponsored by the Air Force is already under way on lubricants that will perform satisfactorily at temperatures of 1,000F or better. These are expected to be quite unusual compounds. One area under investigation by petroleum and chemical researchers that appears promising is the organometallic class of compounds. (AW Sept. 15, p. 23)

Air Force requirement for 1,000F lubricants is, of course, not urgent. (High temperature lubricity problems in rockets are not critical owing to the comparative mechanical simplicity of the engines and the short flight times involved.) Nor do lubrication engineers believe that it will suddenly become so.

Service temperature requirements they expect, will continue to go up gradually. Successors to the 400F oils says Esso's Robert Barnum will probably be 500F or even 450F lubricants. Esso, like other companies, has been looking at a lot of materials over the last nine or 10 years but Barnum says it is still too early to state even what the next generation of lubricants—the one after the 400F oils—will be like, except that they will have high thermal and oxidative stability and reasonable viscosity.

Insistence upon low temperature fluidity in future lubricants is considered impractical. To get the high temperature properties it will need, the Air Force will have to settle for lubricants with relatively high viscosities at low temperatures. Roughly 50 deg. can be added to the high temperature operating limit of a lubricant, says one researcher, for every 10 deg. sacrifice in its low temperature requirement. It is much easier, he adds, to take a lubricant with good high temperature properties and improve its low temperature characteristics by such means as a supplementary heater or diluents than to do it the other way.

Petroleum Reconsidered

A somewhat unusual result of this diminishing emphasis on low temperature fluidity is the re-entry of petroleum oils as future lubricant candidates. Due to the comparatively high bond energy of the hydrocarbon chain, mineral oils possess high thermal stability. And at very high temperatures—an 800-900F engine range is tentatively envisioned—coking and sludge formation with the accompanying increase in viscosity would be kept to a minimum.

The promise of silicon-based lubricants also improves as the temperature goes up. They presently appear to be suitable for service in the 500-700F range. Should some of their present shortcomings prove unamenable to further chemical research, says one engineer, it might prove practical to design an engine to fit the lubricant.

For service over a somewhat wider temperature spectrum, 500-800F, Monsanto Chemical Co. is placing its faith and development efforts in a class of compounds called polyphenyl ethers. The polyphenyl ethers, says Monsanto, are more reliable than the silicones which tend to polymerize unexpectedly are more serviceable over more widespread and significantly higher temperatures and are more resistant to radiation damage. General Electric is also working in this area and recently announced that it had developed a group of polyphenyl ethers that seemed promising.

Fluorine polymers, gaining increasing

acceptance in high temperature applications in the form of gaskets and coatings, are still of only minor interest as high temperature turbine lubricants.

All in all, there appears to be no dearth of high temperature lubricant candidates. At the same time, however, progress on the development of radiation resistant oils is much less impressive.

Radiation is proving to be a formidable barrier, reports Berkey. WADC has been working on the development of oils for nuclear powerplants for some time. Mineral oils perform somewhat better than the synthetic 7808 and 9236A entries and that base stocks without additives appear more promising than those containing additives.

Despite the lack of strong, radiation resistant lubricant candidates, there is no pessimism to be found among researchers in this area. They have managed to keep pace with engine development in the past and see no major reason for not doing so in the future.

PRODUCTION BRIEFING

Packard-Bell Electronics Corp., Los Angeles, Calif., will develop DAFT digital-to-analog function table under contract from Holloman AFB, N. M. DAFT will combine components of the Trice digital computer and the Multiverter analog-to-digital conversion system.

Horkey-Moore Associates, Torrance, Calif., has received a follow-on order from Convair Division of General Dynamics Corp. for additional MB-1 titanium ejection seats. Previous Convair orders for the force ejection seats were for the F-106 fighter.

Minneapolis-Honeywell Regulator Co. will undertake a study of "human engineering" needs in future cockpit design. Contract, valued at $75,000 is from Douglas Aircraft Co., holder of a prime Naval research contract for the Army-Navy Instrumentation Program. After completion of the study, Honeywell will build a cockpit mockup showing control design and layout.

Servomechanisms, Inc., Hawthorne, Calif. will produce true airspeed computers for Lockheed under $476,756 contract. Computer, said to be accurate to + or −2 kt. from 100 to 250 kt., will provide true airspeed input to Lockheed's airborne navigational systems.

Miniature Precision Bearings, Inc., Keene, N. H., supplier of instrument bearings for missile guidance components, has completed a $300,000, 25,000 sq. ft. addition to its Keene facility. The company reports that its 1958 sales were 25% higher than those of 1957.

DORSAL fin on first de Havilland Caribou (above) has been removed on second prototype. Nose probe is used for flight test instruments

Ruggedness Emphasized in Caribou STOL

By Erwin J. Bulban

Downsview, Ont.—Rugged structure for operations from small unprepared fields, and a sophisticated system of flaps and control surfaces to permit taking off with 3½-ton payloads in zero wind over a 50-ft. obstacle in 840 ft., characterize de Havilland's twin-engine DHC-4 Caribou utility transport.

To demonstrate how effective it has been in meeting these specifications, de Havilland Aircraft of Canada demonstrated the Caribou STOL before a large military and civilian audience here recently under conditions that were anything but ideal.

During a heavy downpour, the Caribou made successive takeoffs and landings from an unprepared rain-slicked grass field and lifted off the ground in under 500 ft. while loaded at approximately 93% of its 24,000 lb. gross weight.

The show included making tight turns at slow speeds and low altitude cutting of the port engine and feathering, unfeathering and restart without noticeable loss of altitude. Indications are that de Havilland of Canada engineers are seeking even more impressive performance.

One of the two prototypes is fitted with leading edge flaps to delay airflow separation at high angles of attack and provide higher rate of climb. The test installation is ground adjustable; if proven effective, the flaps will be cockpit controllable.

On the drawing boards are later versions of the Caribou fitted with turboprop powerplants, one of these configurations is planned around the 1,680 shp. Lycoming T55.

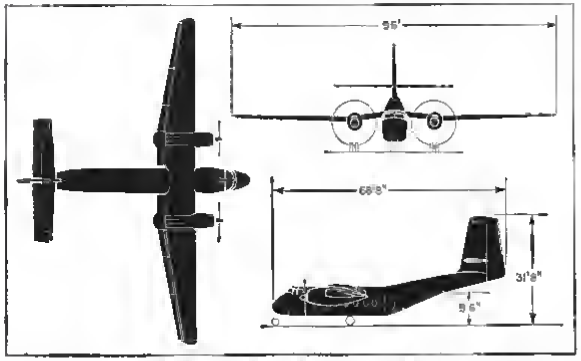
Seven Firm Orders

The company currently has firm orders for seven airplanes; five are going to the U. S. Army beginning next February, one prototype will go to the Canadian government and another Caribou will be delivered to the Canadian Army.

First civilian models will be available for delivery starting March, 1959, the company reports. Basic price quoted by de Haviland of Canada is approximately $495,000. An initial production lot of 20 airplanes has been programmed.

Primarily designed as an all-weather utility transport, available "off-the-shelf" for military use, the Caribou is aimed at providing feeder line and bush-type charter operators a passenger-cargo vehicle capable of carrying a substantial payload to open new sources of revenue and provide maximum traffic volume per hour of utilization at low cost. One field of use would be by Douglas DC-3 operators seeking to extend their current business into areas where that famed transport could not be worked safely because of its runway limitations.

Powerplants chosen to provide high utilization and low operating costs are a pair of Pratt & Whitney R2000-7M2s. They turn Hamilton Standard



SCHEMATIC view of Caribou shows aircraft without dorsal fin, emphasizes high tail and upswept aft section. Wing and horizontal tail and rudder tips are made of Fiberglas

CARIBOU cargo compartment has electrically operated cargo door that runs full width of the fuselage floor. Fuselage cargo area is 73 in. wide, 75 in. high and 25 ft. wide. Floor is 45 in. from ground level. Note cargo roller tracks on floor to expedite loading and cargo handling. Auxiliary ramps are fitted to the end of the lower cargo door to permit driving vehicles into the Caribou, two jeeps can be carried easily. Note how ramp height can be adjusted to various truck bed levels

RIGHT main gear folds forward to provide free fall in slipstream in case of emergency

STABILIZER has 17 deg. up-down travel, leading edge flap is in full up position

INNER wing flaps are in full 40 deg. down position and outer pair are down full 30 deg.

PUMP PRIMERS

by Arthur A. Nichols

Can You Answer These Questions About Gerotor Pumps?

1. How many moving parts are there in a Gerotor pump?

Only 2: ring gear and rotor. The rotor has one less tooth than the outer gear. This "missing tooth" serves as the chamber that carries fluid from inlet to discharge port. *(See Fig. 1.)*

FIG 1

2. What fluids will it handle?

Any fluid of reasonable lubricity in capacities to 100 gpm at pressures up to 1,000 psi.

3. Is it self-priming?

Yes. Under normal conditions, a Gerotor pump can be depended on to pull 28" to 29" of vacuum.

4. Will it handle impurities?

Because of its ability to handle impurities in fluids, a well-known manufacturer of helicopters rates the Gerotor as the best positive displacement pump on the market.

5. Is it dynamically balanced?

Yes. Both moving parts are symmetrical about their turning centers.

6. What kind of valves does it require?

Unlike reciprocating pumps, the Gerotor requires no valves.

7. Is cavitation a problem?

Cavitation does not occur except when the inlet is severely restricted. In any event, cavitation is not normally destructive to Gerotors.

8. What kind of flow does it generate?

A relatively pulseless flow. A large machine tool builder has proved that it produces the smoothest flow among all positive displacement pumps.

9. What are its volumetric and mechanical efficiencies?

Volumetric efficiency ranges between 90% and 95%. Mechanical efficiency is normally about 83% ... up to 66% as outlet pressures approach 500 psi.

10. Can it perform multiple functions?

Yes, and in a single housing! Because Gerotor elements revolve around a common shaft, several sets of elements in various sizes and capacities can be stacked within a single housing to perform lubricating, scavenging, cooling, boosting or other services.

Technical assistance is available and your inquiry is invited

W. H. NICHOLS CO.
Woerd Ave., Waltham 54, Mass.

hydraulic three-blade constant-speed automatic full-feathering propellers. De Havilland notes that the R2000 now has an overhaul time of 1,800 hr. and a record of only one premature engine removal per 20,000 operating hours. Engines are built up as interchangeable power eggs to simplify spares inventories. A portable engine change crane is available which can be fitted to the top of the wing for in-the-field maintenance. Cowlings are "petal"-type, having five hinged panels. Engines are closely cowled for minimum drag at low speeds, and use augmentor exhausts.

Caribou and its equipment are designed to operate over an ambient temperature scale ranging from −40F to +120F; winterization kits will be available to extend the low end of the range to −65F.

Airplane and its equipment actually will be capable of working up into the range of +160F without breakdown, the company reports.

For cold-weather flying, de Havilland will supply separate combustion heaters for cockpit and cabin capable of maintaining a minimum temperature of 40F while the outside reading is −40F.

In addition to short-field takeoff capability with zero wind, Caribou performance analysis depicts a takeoff run of only 460 ft. over a 50-ft. obstacle with a 20-mph. headwind and a landing distance over 50 ft. of 590 ft. Using International Civil Aviation Organization (ICAO) piloting technique, the Caribou is designed to make instrument approaches at 80 mph. The aircraft is designed to be capable of climbing out, should an engine fail on takeoff just after leaving the ground with takeoff flap and landing gear extended.

De Havilland of Canada reports these typical load analysis data:

- As a freighter, Caribou will carry 7,383 lb. of cargo over a stage distance of 200 stat. mi. with 1,150 lb. usable fuel. Over a 400-mi. stage length, 6,713 lb. of cargo can be carried with 1,820 lb. fuel; over 600 mi., 6,038 lb. can be airlifted with a fuel load of 2,495 lb.; over a stage length of 800 mi., 5,368 lb. of cargo and 3,165 lb. of fuel are carried.
- As a passenger plane, the DHC-4 can be loaded with 27 passengers, 1,863 lb. of baggage and cargo and 1,150 lb. of fuel for a stage length flight of 200 stat. mi. Over 400 stat. mi., a load could consist of 27 passengers, 1,193 lb. of baggage and cargo and 1,820 lb. of fuel; over a 600-mi. stage length, 27 passengers, 518 lb. of baggage and cargo and 2,495 lb. of fuel could be loaded, and over an 800-mi. stage length, a load could consist of 25 passengers, 178 lb. of bags and cargo and 3,165 lb. of usable fuel.

Fuel loads consider climb, cruise flight, descent and a 45-min. reserve at

cruise speed. Crew of two is included in freighter and passenger analyses.

Military versions are designed to carry 28 fully equipped combat troops or 22 paratroops, an air medical evacuation configuration will take 14 standard army litters and 10 seats for attendants and/or ambulant cases. Cabin, of 1,000-cu ft capacity, can hold two jeep type vehicles.

Loading is facilitated by using a large rear loading door measuring 73-in. wide by 75-in. high. The door retracts electrically into the cabin roof and can be opened in flight to provide an exit for paratroops or carriage of long cargo that cannot be entirely enclosed in the cabin. Loading door is jettisonable for use as an emergency exit. An overhead cargo monorail can be fitted that is capable of handling loads up to 2,000 lb. in conjunction with a winch mounted forward in the cabin.

Fuselage Doors

Passengers can enter the cabin through doors on the left and right of the aft fuselage in addition to the retractable cargo door. Crew entrance can be made through a door under the belly, when the cabin is fully loaded with cargo. Underbelly hatch can also be used for emergency exit. Crew can also exit through an emergency hatch in the cockpit roof.

Structure is fairly conventional, yet considerable attention has been paid to providing extra ruggedness to cope with heavy utilization, operation in unprepared areas and for crash-worthiness. Even though several ingenious approaches are used to provide lightness without sacrificing structural strength, crash-safety provisions add some 300-400 lb. to the Caribou's airframe weight, members of the design staff told AVIATION WEEK.

Fuselage comprises three major prefabricated assemblies: nose cap and cockpit, center fuselage comprising the cargo compartment and passenger cabin, and the rear fuselage which includes the cargo doors and full monocoque section supporting the tail. The latter assembly now is built as one but later will be split into two units.

Nose structure is built around a large nosewheel box assembly, which actually forms a spine under the floor of the cockpit area. Nose wheel box is made up on large swaged panels and shear panels of rectangular corrugated section. Swaging process saves considerable weight and assembly time, every swage saves a part, William T. Heaslip, deputy chief design engineer, noted. This box, weighing approximately 50 lb., carries all nose gear drag strut loads and transmits them to the aft bulkhead rather than through the intermediate structure.

A major longeron on either side of the nose assembly ties rear and forward bulkheads together and together with the nose gear box would handle damage loads from the nose rearward without compromising the cockpit "safety island" which is loaded independently, the floor being carried on half bulkheads fore and aft.

Cockpit area is high in the nose section to provide crew with good all-round view, which is further improved by the downward-cranked wing center section. Cockpit transparent area totals 32 sq. ft. and provides pilots a 265 deg. arc from wingtip to wingtip and 183 deg. from nose to tail. Vision over the nose shows the ground 15 ft. in front of the aircraft. Windshield is birdproof type.

Layout is such that the Caribou can be handled by a single pilot, if necessary. Engine controls are placed on a console mounted in the roof and the throttles are located at shoulder height. In the same bank with the throttles are pitch and mixture controls. Landing gear lever is placed at the end of the throttle travel to provide a smooth follow through gear-up cycle. Aft of the engine controls on the overhead console are aileron trim, ignition switches, flap control and carburetor air temperature controls.

Fuel cocks are positioned at the rear of this console, the system consisting of three cocks—the outboards, allowing

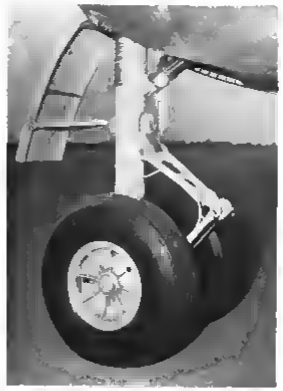
fuel from left or right engines to feed their respective engines, and the center cock permitting fuel to flow to its adjacent engine or both engines. It can only be used in conjunction with any one of the other two cocks to prevent one engine being supplied from two tanks at once.

Radio control console is set between the pilot and copilot and is mounted on tracks so that it can be slid forward toward the instrument panel to provide additional crew movement space.

Nose wheel steering wheel is on the port side of the cockpit. Gear retracts backward, with the rear doors cycling open as the gear folds and closing when it is inside. Doors close while the gear is down to prevent foreign object entry in the gear well. Nose gear provides power steering over a 124 deg. radius providing the aircraft with a 27 ft. turning radius. Nose installation on this gear has a variable ratio between steering motor and axle providing low speed for taxiing when sharp turns are to be avoided, and high speed when moving slowly to allow sharp turning.

Main landing gear retracts forward into the nacelles, providing slipstream assist in emergency free-fall extension. Like the nose wheel, the main gear struts have two-stage shock absorbing action developed by Jarry Hydraulics, Montreal. Long stroke is designed to handle a 14½ ft./sec. rate of descent to absorb shock of short field landing technique, short stroke action comes in to provide less damping while the airplane is taxiing over rough ground, minimizing nose and wing dipping. Short stroke cycle also provides very small deflection of the fuselage while the aircraft is being loaded with cargo.

In the case of the main gear, the designers had to cope with the problem



NOSE gear provides power steering for pilot, gives aircraft 27 ft. turn radius.

of retracting a strut having long stroke shocks into a minimum-size engine nacelle. This was done by containing the shock absorber in a cupsnk that is retracted into the main strut as it swings forward and up, shortening the main gear by some 18 in. Main gear legs are identical and completely interchangeable to reduce spares requirements.

Landing gear and brakes and nose wheel steering are operated by a 3,000 psi hydraulic system independent of engine-driven pumps. Power source is an electric pump consisting of a readily removable power pack assembly including accumulator, reservoir and other units.

Emergency system for the nose gear, to provide it with the fail-safety characteristic of a free fall main gear, includes a separate hand pump and a "blow-down" compressed air bottle.

Should the electrical system or main hydraulic pump fail, the accumulator can be manually pumped to provide full operating pressure. Brakes, served by the main hydraulic accumulator, also have an emergency accumulator which can be recharged manually. There is also a manually operated air bottle.

Electrical system consists of two 300 amp 28 v d c low-speed generators operating at engine idle speed to provide constant charge. Alternating current systems handle flight instrument operation and windshield deicing. Wiring is fitted for ready access with minimum removal of upholstery.

Mid fuselage is designed to take the weight of the wings, engines and fuel in the event of a belly landing—it actually is built to take these forces through several belly landings safely for crew and passengers, Aviation Week was informed. Belly integrity is provided by a

De Havilland-Canada DHC-4 Caribou

SPECIFICATIONS	
Wing span	96 ft.
Wing area	912 sq. ft.
Mean aerodynamic chord	120.8 in.
Aspect ratio	9.9
Overall height	31.8 ft.
Over all length	68.6 ft.
Cabin width	7 ft. 3 in.
Cabin height	6 ft. 3 in.
Cabin volume	1,000 cu. ft.
Passenger capacity	27
Fully armed troops	28
Propeller diameter	13.1 ft.
Propeller clearance to fuselage	15.6 in.
Propeller clearance to ground (fully loaded)	21 in.
Horizontal tail span	36 ft.
Horizontal tail area	230 sq. ft.
Vertical tail height	18 ft.
Vertical tail area	211 sq. ft.
Landing gear track	23.1 ft.
Wheel base	21.9 ft.
Ground clearance under fuselage (fully loaded)	32 in.
Performance (24,000 lb. gross)	
Cruise speed (@) 62% power (@) sea level	171 mph. TAS
Cruise speed (@) 62% power (@) 7,500 ft.	183 mph. TAS
Stall speed (landing flaps)	60 mph.
Service ceiling (two engines)	24,900 ft.
Service ceiling (single engine)	10,500 ft.
Maximum range	1,350 stat. mi.
Takeoff distance (short field technique, sea level, zero wind)	490 ft.
Takeoff distance (short field technique, over 50-ft. obstacle, sea level, zero wind)	840 ft.
Landing distance (dry, concrete, short field techniques, zero wind, sea level)	425 ft.
Landing distance (short field technique, over 50 ft. obstacle, zero wind, sea level)	1,000 ft.
Takeoff distance (airline technique)	885 ft.
Takeoff distance (airline technique, over 50-ft. obstacle)	1,305 ft.
Landing distance (airline technique)	565 ft.
Landing distance (airline technique, over 50-ft. obstacle)	1,305 ft.
Rate of climb (two-engines, takeoff flaps)	1,500 fpm.
Rate of climb (one-engine, takeoff flaps)	315 fpm.
Rate of climb (after takeoff, flaps up, two engines)	1,830 fpm.
Rate of climb (after takeoff, flaps up, one engine)	460 fpm.

grid of three heavy beams having shear webs made up of swaged 24ST and 75ST capping material. Transverse members are spaced 17 in. apart. These beams serve as longitudinal skids in the event of a belly landing. Vertical and side crush loads are taken by a bulkhead at station 138 and by massive two-piece pressed frames at the front and rear wing spars and at the rear of the cabin. Floor is made up of metal-faced honeycomb.

Wing center section drops into a cut-out in the top of the mid fuselage, and spars are attached to massive joints. A two-piece linked connection ties the wing to the fuselage, permitting the wing to take out connection stresses.

Rear fuselage assembly is built around the horseshoe-shaped hoops carrying the retractable cargo doors. At the forward cutout a massive frame consisting of two riveted pressings riveted along stiffeners provides elastic restraint to the long longerons along the cutout areas. The retractable door is a single-piece assembly having bonded ribs. Aft section, carrying tail, is a conventional monocoque layout. Fuselage assemblies are permanently joined by riveted butt strap joints.

Wing Assembly

Wing assembly comprises a downward cranked rectangular center section and two tapered outer panels built around two main spars designed only to provide shear.

Heavy skins in combination with stringers take at least 90% of bending loads. Spar webs and ribs are of 24-ST. Skins on outer panels—upper skins are 14ST6 used because of its superior compression yield strength, lower skins are 24ST3 for improved notch sensitivity—taper from .06-in. at the center section to .03 at the tips.

Additional strength is provided in the form of "glued" reinforcement patches at all important tension joints. Patches are additional riveted metal adhesive-bonded to joints with Barrington Rubber FM47.

Wing transport joint of the center section to outer panels consists of a series of forgings—one between each stringer—with a tension bolt picking up the skin and one stringer. Bolting faces are machined in the wing jig to a flat surface to a tolerance of + or —1/1,000 in. 10 mm.

Outer wing panels each contain 10 interconnected flexible bladder fuel cells having a total capacity of 770 U.S. gal. Tanks lay on curved Fiberglas panels resting on downward bowed strips between ribs. Access to tanks is provided by a series of oval openings in the wing underskin backed by machined adhesive bonded patches. Wing ribs 2 through 13 are of tension field construction with vertical corrugation approximately ¾-in. thickness, also giving lateral strength to support fuel tank slosh loads.

Wing section is a 40% thickness airfoil developed by de Havilland Canada from NACA's family of low drag airfoils. Camber line moves forward and camber increases toward the wingtips to delay stall in this region.

Double Slotted Flaps

Wings are fitted with double slotted flaps from tip to tip with four sections in each wing comprising a total of 16 flap units which make up some 38.0% of the total wing area. De Havilland Canada engineers say they are seeking better lift coefficients with the Canberra flap layout than would be possible using "sucking and blowing" boundary layer control systems.

Of the four double-slotted flap sections on each wing, trail portions of two outer sections are also ailerons, providing the pilot with considerable lateral control while flying at low speeds and high nose angle. To provide a gage of extent of flap and aileron action, here are figures on travel:

- **Root and inboard flaps** can be extended 40 deg. and their trailing sections an additional 22½ deg.
- **Mid and outboard flaps** can be extended 30 deg. down. In this condition the aileron on the mid flap has an

available travel of 21 deg 15 min up and 15 deg 30 min down.

When flaps are at zero degrees, this aileron has up travel of 9 deg 45 min up and 5 deg down. In the 30 deg down position of outboard flap its aileron has an up travel of 25 deg and a down travel of 20 deg. In the zero degrees position, ailerons of the outboard flap have a travel of 24 deg up and 15 deg 30 min down. Horizontal stabilizer adjusts incidence automatically with flap travel to provide trim and prevent pitching. In addition the horizontal tail has reverse camber and incorporates a fixed "island" on the stabilizer to provide slotted benefit to the elevator, giving it a higher lift coefficient as it travels upward to prevent stall.

Victor Bomber Operations Will Require Crew Training Changes

Cottesmore, England—Handley Page Victor bombers will require far-reaching changes in crew training and maintenance requirements now in the process of being made by Britain's first operational Victor squadron here.

The swept-wing bombers will be flown and maintained by No. 10 Squadron of No. 3 Group, Bomber Command. A second squadron, No. 15, is now being formed and will be operational at the end of the year. A photo-reconnaissance version of the Victor has been operating from Wyton for some time.

Closer control over aircraft maintenance will be provided by a ground crew chief who will fly with the Victor crew on all but operational missions. Crewmen also are grouped together in the forward section, rather than stationed throughout the airframe as in previous bombers.

No. 10 Squadron, one of the most distinguished in the service, operated with Handley Page Halifax bombers during the last war and collected a mixed batch of DSO, DFC and DFMs totalling 515. It gained the annual Premier Bombing Prize during a postwar period with Canberras and led the bombing assault on Egypt's air fields.

Present Victor has Sapphire turbojet engines but is shortly to be equipped with the Mk. 2 version which has Rolls-Royce bypass engines of about 17,500 lb. thrust. The Mk. 2-engined aircraft will also mount a constant thrust de Havilland Spectre rocket in jettisonable pods under each wing. The pods have parachute gear and will be recovered for further use. Armament will be the Avro stand-off bomb.

No. 15 Squadron is also in the process of being reformed with Victors at Cottesmore and should be operational by the end of the year. It also has been revealed that a photographic reconnaissance version of Victor has been operating from Wyton for some time.

Both squadrons are part of No. 3 group Bomber Command under Air Marshal Kenneth Brian Boyd Cross who, prior to his present appointment, held successively the posts of Director of Weapons and of Air Defense at Air Ministry. Britain's top scoring fighter ace, Group Capt. James Edgar (Johnnie) Johnson, commands the station.

The Victor is now equipped for flight refueling through a boom extending forward above the cockpit (AW Sept. 8, p. 27). But the squadron has not yet started flight refueling exercises. On a hose weight basis, strength of the boom is one of the principal factors fixing the separation distance from the tanker aircraft and according to one of the engineers at Cottesmore the present arrangement is not without some handicaps. It introduces the possibility of the refueling hose fouling the cockpit windshield in the event of severe differential height changes which could lead to a pressurization failure.

Wing Commander Charles Owen, an ex-Pathfinder captain, who commands No. 10 Squadron, speaks highly of the pressurized cabin configuration which groups all five crewmen together, noting "it gives a feeling of compactness and crew unity not present with the dispersed crew locations in other V-bombers."

Maximum pressure differential is 6½ lb. psi but this is not fully developed for reasons of training efficiency which must recognize the contingencies of loss of pressure in combat.

A sixth seat is being provided for the ground crew chief on occasions when the aircraft will operate from bases away from home. He will supervise refueling and ground servicing operations which have now acquired some complexity.

Rigorous crew selection system includes personal interviews with Air Vice Marshal Cross. Most pilots and navigators possess extensive Canberra and Valiant experience and the captains are war veterans. Average age of the Victor crew is well over 30. Prestige is only one of the reasons why Canberra crews welcome the Victor posting. Copilots include men straight from training. Two navigators and an air electronics officer occupy rear-facing seats mounted side by side. Navigator in the center

"FORCES OF NATURE," another in a collection of paintings by Simpson Middleman, two talented artists who find in the natural sciences the subject matter for their contemporary expressions. Courtesy John Heller Gallery, Inc.

Conquest of space

Boeing has geared its facilities, research and manpower resources to meet the complex technological requirements of the space age. The Systems Management Office, for example, has responsibility for the over-all management as well as the technical research and development activities in advanced flight technology, electro-magnetics and support systems leading to operational space weapon systems.

The Boeing Scientific Research Laboratories have been established to develop new, fundamental knowledge at the frontiers of science. They provide the environment of scientific freedom necessary to the attainment of this objective. Areas of investigation include, but are not limited to, hypersonics, energy conversion, solid state physics, magneto-hydrodynamics, nuclear and plasma physics, advanced propulsion systems, and the effects of high temperatures on structures and materials.

Boeing engineers and scientists are currently at work on an Air Force assignment for Phase I development of Dyna-Soar, a manned space vehicle which will orbit at speeds approaching 18,000 miles an hour and be capable of re-entry and normal landing.

Dyna Soar and other advanced projects at Boeing offer exceptional space-age opportunities to engineers and scientists of all categories. Drop a note now to Mr. Stanley M. Little, Department C-80, Boeing Airplane Company, Seattle 24, Washington.

BOEING

seat concentrates on the radar and blind bombing systems while the other navigator plots courses.

Superlative competitive bombing efficiency of U. S. Strategic Air Command crews (a British crew was well satisfied to finish 11th in the last competition) is not considered to be entirely due to superior equipment but to crew experience, AVIATION WEEK gathered from one crewman. According to Cross, some SAC crews have been together for over seven years adding "we hope to be able to keep Victor crews together for at least a five year tour."

The gimbal-mounted radar scanner and the computer of the blind bombing system are mounted in the plastic covered lower portion of the front fuselage. System is highly classified and even the makers—two well known and independent companies—responsible for the radar and computer respectively cannot be revealed. The equipment includes the Marconi Doppler navigational system.

Simple to Handle

Apart from the favorable speed and handling characteristics at altitude, pilots cite improved visibility and superior approach, landing and even taxiing features of the Victor. Captains with Vulcan and Valiant experience said that the Victor was an astonishingly simple aircraft to handle during the approach and landing phases.

Technique is to approach with a constant power setting using the flaps progressively as the approach proceeds. This is not possible with the Vulcan it was explained, because that aircraft develops most of its drag early in the approach which leads to some throttle pumping. Pilots generally confirm the tendency for the Victor to round itself off automatically during landing, a feature proclaimed by the makers, Handley Page Ltd.

Handley Page designers attribute the superior handling characteristics over wide speed and altitude ranges to the aircraft's crescent wing planform which employs progressively reduced sweep toward the tip, delaying stall at the outboard region. Outboard leading edge flaps are also fitted. High tail position was favored because it frees the tail from wing and fuselage shock effects. Air brakes on rear fuselage have no effect on trim.

Stress corrosion due to overtightening of a bolted tailplane joint grounded the squadrons eight aircraft last month. Revision of assembly routine was the cure.

Growing incidence of duodenal ulcers among jet bomber crews has been attributed to irregular meals and too much fatty food of the fried bacon and French fried potato variety. Diet revisions are being introduced and cooking facilities improved. Crews now are

promised more omelettes and fresh fruit before flights, and steaks afterwards. Hot soup has been introduced into the flying ration and a new oxygen mask has been developed which allows the airman to take soup through a polyethylene tube without having to remove his mask. Soup is heated on a small electric element specially provided in the cockpit.

Ejection Procedures

Captain and copilot have ejection seats while the rest of the crew bail out of the side door of the cockpit. A new type of parachute is being developed which will relieve the present discomfort of the seat type pack during flights of long duration.

In a reference to bombing tactics Group Captain Johnson dismissed the tactical merits of skid-type bombing techniques with aircraft the size of the V-bombers.

The rolls and loops demonstrated by the Victor and Vulcan aircraft at the recent Farnborough show, he said, was a "circus act." They might sell aeroplanes but "were without tactical and strategic implications." Johnson contended.

In the words of Air Vice Marshal Cross: everything was "subordinate to going to war in a hurry." Victor crews believe they will also get back "at least to an alternative base."

USAF Seeks Uniform Air Cargo Handling

Contracts for development of a standardized aircraft cargo handling system have been awarded to Douglas Aircraft Co. by the United States Air Force.

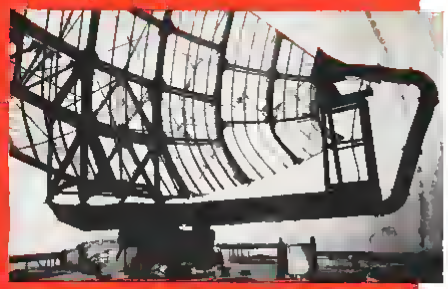
System will be installed in a Douglas C-133A and will undergo operational suitability tests by the Air Force.

Using roller conveyors and pallets, the system is capable of off-loading 90,000 lb. of cargo from a Cargomaster and reloading the same amount in approximately 30 min.

One contract covers the design and fabrication of a set of track structures, 53 cargo pallets and 33 cargo cages. Pallets, 7 x 10 ft. in size, will be constructed of aluminum with paper honeycomb core developed by Douglas Aircraft.

Side guard rails will permit latching of pallets securely in place.

Contracts are the result of a Douglas study to adapt the system to the aircraft with high cargo doors such as Douglas C-54, Boeing C-97, Douglas C-118, Lockheed C-121, Douglas C-124, Boeing KC-135, Douglas DC-8 and various other aircraft of the Civil Reserve Air Fleet.



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Aviation Week

Including Space Technology

1959 BUYERS' GUIDE

USAF Reveals Cessna L-27 Cost Data

By Robert I. Stanfield

New York—First detailed logistical data covering one-year Air Force utilization of commercial, "off-the-shelf" aircraft point up the low operating cost—$15.98 per hour—of the L-27A, military counterpart of Cessna's five-place, twin executive Model 310B.

For the first year—covering 80 aircraft utilized an average of 70 hr. each per month—total cost of actual logistical spares support was $2.23 per hour. Labor costs averaged $3.41 per hour.

By November USAF will have received 160 L-27s at a cost of $8.9 million. Deliveries of the initial order of 80 aircraft, on which this data is based, began in May, 1957, and ran through December of that year. Deliveries on the second order, for an additional 80 aircraft, began last May.

L-27 Powerplants

Airplane is powered by two six-cylinder Continental O-470-M engines rated at 240 hp. at 2,600 rpm. Maximum cruise speed is 201 kt., endurance is 6 hr. Maximum gross weight is 4,830 lb., 130 lb. more than the commercial version.

Its basic mission is personnel transportation, coupled to this is its adaptability as a light cargo carrier and an instrument trainer.

Supply support for the L-27A is not available through the normal Air Force supply system. Contracts covering USAF purchase of the airplane include provisions for maintenance inspections and replacement overhaul of aircraft parts through 16 Cessna distributors-dealers. These four contracts run as follows:

- **Basic airplane cost.** Price of the L-27A, fully equipped, is in the $50,000 category. USAF package includes vinyl plastic interior and following communication and radio navigation equipment: two ARC 15-D omni localizer receivers, Wilcox 700B glide slope system, Narco 1016 400-channel transceiver, ARC T-11B standby VHF transmitter, ARC 21A low frequency ADF radio compass. Similarly equipped civilian version (Model 310B) would cost about $79,889.
- **Call contract.** USAF can requisition, on DD Form 1155, some 400 day-to-day parts direct from dealers. Should the dealer be out of stock, the part can be ordered direct from Wichita, Kans. USAF orders high-value parts direct from its bonded warehouse at the Cessna plant in Wichita, in which are stocked 18 items, including engines, generators, starters and propellers. Cessna has set up a backup parts stock for USAF so that the service won't run short on high-cost items from its bonded warehouse.
- **Crash damage contract.** A modification and/or engineering assistance contract for time and services only. Cessna will appoint a qualified dealer to fulfill its requirements.
- **Overhaul contract.** This is a repairable contract on high-cost items, work being done by vendor on his own premises. All original vendors who provide equipment new are also repairable vendors. An engine being overhauled, for instance, would travel from a particular USAF base to Cessna, thence to Continental for overhaul, from which it would return to USAF bomb-room at Cessna. The base, meanwhile, would draw a replacement engine from the bonded warehouse.

USAF has estimated total operating costs for the L-27A to be $16.38 per hour. However, usage cost computation, running through June 30, 1958, averaged out $15.98 per hour. The estimated figure ($16.38) is based on the following data:

- **Cost of operations** estimates compiled during Phase VI test at Edwards AFB, Calif., which covered 301.5 test hours. During this period cost of parts was $793.54; cost of labor as $1,027.68; total was $1,821.22. Dividing total cost by test hours flown gives hourly maintenance cost of $6.04.
- **Fuel and oil** estimates over this test period. At 19 cents per gallon, total fuel consumed—4,854 gal.—cost $922.26. At 15 cents per quart, total oil consumed—204 qt.—cost $30.60. Again, dividing total cost ($952.86) by 301.5 test hours flown, average consumption cost is $3.16 per hour.
- **Overhaul reserve** estimates are based on 80% of allowable maximum under existing overhaul contracts. Cost of engine and accessories overhaul runs $4.90 and $4.09 per hour, respectively.

CESSNA L-27's flight performance characteristics include good lateral control with one of the engines feathered.

L-27A USAF Assignments —160 Aircraft

COMMAND	FIRST	SECOND
	80	80
Air Defense Command	25	6
Air Material Command	10	12
Air Research and Development Command	13	7
Air University	2	2
Strategic Air Command	4	20
Air Training Command	14	
USAF Headquarters	2	21
Continental Air Command	10	
Military Air Transport Service		12
Total	80	80

following 800 hr utilization. With 80% allowable, total equipment overhaul cost—$8.99 per hour—is $7.18 per hour. Basis for estimate follows:

New engine costs $3,011.57. Maximum overhaul, allowing 65% of the cost of a new engine, would run $1,957.52. Divided by engine time at overhaul—800 hr—cost would be $2.45 per engine or $4.90 per hour for two engines. (Cost of first L-27 engine to be overhauled was $1,201.80. Of this amount, $642.27 was for labor—at $5.50 per hour—and $554.53 was for parts.)

Accessories (including radio) overhaul cost of $4.09—after 800 hr utilization—is based on:

1. Components list price. Propeller, $326.98; vacuum pump, $53.03; generator, $177.12; fuel pump, $61.57; carburetor, $202.53; boost pump, $107.30. Maximum allowable overhaul cost—$928.53—divided by 800 hr—runs to $1.16 per engine or $2.32 per hour for two engines.

2. Radio overhaul. This would include transceiver as highest cost item, and ommi meter. Cost, $1,413.10, divided by 800 hr., runs $1.77 per hour.

Usage Computation

During the period beginning May, 1957, and running through June 30, 1958, actual hourly operating costs of the L-27A—$15.98—were hinged to:

- **Actual logistical spares support** of $2.23 per hour. DD Form 1155 sales through dealers through June totaled $100,000. Bond room repairables contracted totaled $50,000. Average monthly aircraft utilization—70 hr per aircraft, times 80 aircraft—was 5,600 hr. Multiplying latter figure by 12 (average monthly age per airplane) gives 67,200 estimated total hours flown through June.

Parts cost figure—$2.23 per hour—comes from dividing $150,000 by total hours flown.

- **Labor costs**—derived from Phase VI testing—are $3.41 per hour. Basis: $1,027.68 for labor over 301.5 test hours.
- **Fuel and oil costs**—also derived from Phase VI testing—of $3.16 per hour.
- **Equipment and engine overhaul reserve**, again based on Phase VI testing—$7.18 per hour.

Cessna's 16 distributors, dealers designated as L-27 parts suppliers have agreed, via contract, to maintain a specific stock level covering about 400 day-to-day parts in the call contract. This would be in addition to their normal stock supply.

The suppliers, set up on a geographical basis, work hand-in-hand with local USAF bases, serving transient as well as permanently based L-27s. The USAF installation to which aircraft are assigned is responsible for organizational and field level routine maintenance. They can, of course, do their own work.

Parts are purchased from suppliers by USAF at "military cost" (more economical than retail). The list of 400 items is reviewed for price every three months by Cessna and USAF's Air Materiel Command (AMC).

High value items, purchased by USAF, are stored in the bonded warehouse at Wichita.

Major Maintenance

Major maintenance—such as that which would be involved in a crash-damage contract—is the responsibility of AMC. Procedure here would be for a local base to notify AMC of damage incurred. Latter would contact Cessna as to where the aircraft is to be repaired.

Repair estimate would be submitted by the distributor to Cessna which, after surveying it, would forward an estimate to AMC for approval. If approved, the distributor bills Cessna which pays for cost and then, in turn, bills the Air Materiel Command.

No money changes hands between distributor and USAF, even for small parts, unless the local base prefers to use its own funds. Normal channel is for the distributor to bill Cessna, which bills AMC, which in turn apportions cost to local bases. Cessna will appoint additional distributors as the need arises.

The L-27 military program is the responsibility of Cessna's government relations department, headed by W. D. Eikenberry, and established solely to handle the sale of readily available commercial aircraft to government agencies. Program is presently restricted to USAF; however, its economies reportedly have prompted Army and Navy interest.

Additional field support is rendered by five Cessna field service engineers—all commercial pilots—who periodically call on L-27 bases throughout the country. Cessna also provides check out of USAF instructor pilots—at cost to Cessna—at installations receiving the L-27.

Airplane's high utilization rate was evidenced in a spot check of 10 Air Force bases. Check covered 21 aircraft, in use a total of 144 months, with accrued total time (for all aircraft) of 10,137 hr—an average of 70.4 hr per month for each L-27. The high was reached by Air Defense Command's Ent AI B, Colo., which over an eight month period averaged 115 hr. per month for four aircraft.

Performance and capabilities of the commercial Model 310, counterpart of the L-27A, were stressed in the first flight evaluation report on this airplane by AVIATION WEEK (AW July 16, 1956 p. 50).

The L-27 also was flown by this editor in conjunction with this story, and during a two-week active duty tour with USAF. L-27 popularity with service pilots stems partially from the following performance characteristics:

- **Handling.** Airplane is sensitive but smooth to control pressures. Little

L-27A Performance

(USAF TEST RESULTS AT GROSS WEIGHT OF 4,530 LB.)

True air speed at 60% power at 10,000 ft	183 kt
Range at 10,000 ft., 121 gal. fuel used	1,285 n m
Two-engine service ceiling (100 fpm.) at best power, allowing for fuel used	20,400 ft
Single-engine service ceiling (50 fpm.) allowing for fuel used	7,500 ft.
Takeoff over 50 ft. obstacle, sea level	1,230 ft.
Land over 50 ft. obstacle, sea level	1,610 ft
Rate of climb, sea level	1,640 fpm
Single-engine rate of climb, sea level	340 fpm
Maximum cruise speed, sea level	201 kt.
Endurance (60% power) at 10,000 ft. using 121 gal. fuel	6 hr.
Stall speed, cruise configuration	54 kt. IAS

rudder application is necessary, ailerons do most of the work

• **Speed** The L-27 moves along at a good clip. Cruising at 7,000 ft with three of us aboard, pulling 62% power —22.5 in. manifold pressure and 2,300 rpm—airplane indicated 187 mph for true air speed of 216 mph.

• **Single engine** Good lateral control was evidenced with one engine feathered, 50 deg. banks to either side being no problem. During touch-and-go landing right engine was pulled back in roll before go-around; climbout was made at 350 fpm.

• **Stalls** Again good lateral control was evident. Wing twist negates wingtip stall and safe flight stall warning precedes break by about 8 mph. With gear down and pulling 12 in. mp, L-27 broke at 60 mph. IAS with full flaps, 72 mph IAS with 15 deg. flaps.

Airplane is equipped with a high pressure oxygen system which converts to low pressure automatically regulated for pilots' use. Gear and flaps are electrical. Hydraulic pressure is used solely for disk-type brakes.

Auxiliary Tanks

In addition to the difference in maximum gross weights of the L-27A and Model 310B, the former comes equipped with auxiliary tanks (15.5 gal. each) in the wings, an optional item with the commercial model.

The military version does not come equipped with deicer boots and propeller anti-ice systems, also offered as optional equipment on the 310B. But during Phase VI testing by USAF, the recommendation was made that the aircraft be exempt from AFR 60-16, which prohibits flight into known icing conditions without icing provisions.

Cessna is turning out 25 310B L-27As monthly and the rate can be increased to between 50-50 a month without tooling or expansion costs to the government, Aviation Week was told.

Between March, 1954, when the airplane was CAA-certificated, and the end of this year, 826 Model 310s will have been built and delivered, plus the 160 L-27s for USAF. Basic cost of the commercial version is $59,950; average 310B, with equipment, leaves the factory at a cost of $68,500.

L-27A Hourly Military Operating Costs

	Estimated	Actual
Fuel and oil	$3.16	$3.16
Maintenance (organizational and field)	6.04	5.64
Equipment overhaul	7.18	7.18
Total hourly operating costs	$16.38	$15.98

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The advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, SEPTEMBER 29, 1958

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

ADVERTISERS INDEX

LETTERS

Unpleasant News

Congratulations on your TIMELY editorial, "Stoned in Athens" (AW Sept 15, p 21). Perhaps it is only the LIFE or the LOOK of life that has caused so many to wish to stone messengers who distribute unpleasant news.

Your comparison on Senator Saltonstall's manufactured statements to those of Senator Symington is certainly an eye opener. May you continue to publish more such editorials.

RICHARD L. AUTEN
Stratford, Conn.

Morning Newspaper

Perhaps this will add kindling wood to an already hot fire...but your July 7, Aug 11, Aug 18, and Sept 8 issues (swivel necking—VFR IFR—see and be seen) have prompted me to relate an experience I had last week.

Purpose: To transit 200 air miles from a very large midwestern city to a smaller midwestern city.

Mode of transportation: Large domestic and international air carrier—Lockheed Super Constellation type aircraft.

Setting: Early morning daylight hours. Weather clear. Visibility good. Full load of first class passengers.

My seat was about one-third of the way aft on the right side next to the center aisle. The stewardess had left the cabin door(s) to the cockpit open so I had a clear view of most of the captain's right arm and part of the left side of the cockpit.

Approximately 10 min after takeoff, the pilot occupying the left seat (the captain) picked up the morning newspaper and spread it in front of him on the yoke. The paper maintained this position until we approached our destination (approximately 45 min elapsed). I can't say the pilot in the left seat was reading the morning newspaper because I couldn't see his eyes but what am I to assume? Perhaps the shoe salesman with the brown star (AW Sept 8, p 118), circa August, had something after all!*

ROBERT L. REX
Ex Navy Pilot
Batavia, Ill.

*It appears that some people aren't trying.

Weight vs. Reliability

Would Mr. John Tunstall (one of your engineering writers) be so kind as to amplify for me a statement in the edition of AVIATION WEEK dated Aug 18? On p. 64 there begins an article (by Tunstall) headed "Transmission Design Cuts 192's Weight." The first paragraph then states: "Weight-saving potential of a transmission development designed to assure uniform tooth loading has been traded for reliability in the Bristol 192 military helicopter." These two statements imply that the Bristol's design team has considered weight savings to be more important than reliability—a conclusion which (by appearing in the first paragraph of the article) leaves the reader with a very adverse opinion of this design. Having read this, I naturally looked for substantiating facts—but they are completely absent. The test rig to achieve uniform tooth loading is described but the means by which this technique adversely affects reliability are not mentioned—not even the word "reliability" appears again in this context. In fact, if a reader has not been heavily biased by the opening paragraph he might reason that uniformity of tooth loading would by eliminating fatigue crack creating stress peaks, improve the reliability of the transmission.

I would, therefore, be most obliged if your Mr. Tunstall could justify technically his opening paragraph.

H. C. SEVIER
Winnipeg, Canada

(The ambiguous word "traded" led reader Sevier and the headline writer to misconstrue Mr. Tunstall's opening paragraph. If the word "sacrificed" is substituted for "traded," the correct interpretation of Bristol's design philosophy becomes apparent—that reliability is more important than weight-saving potential. Bristol's transmission development ensures even stress distribution along tooth flanks thereby lowering local peak stresses. Bristol could have reduced weight of the gear, retaining the same stress levels and same fatigue life, but instead chose to retain the same gear weight to achieve lower stress levels and longer fatigue life and, consequently, more reliability.—Ed.)

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Historic Teams

Previous letters to AVIATION WEEK on the subject of precision flying in the military appear to have overlooked two of the real pioneers: the Army Air Corps Three Musketeers and the Navy's Three Sea Hawks. The Musketeers were the star performers at the 1927 National Air Races at Spokane. Flying D-12 engined Curtiss P-1 Hawks, their formation aerobatics made the pick-up Navy team in Packard-powered Boeing FB-5s appear quite amateurish.

This sad situation was duly noted by Lt. D. W. Tomlinson then under orders to the Navy's Fighting Squadron Six. Under his encouragement an extensive program of aerobatics was begun and was intensified when he assumed command of the squadron in 1928. Re-equipped with Wasp-powered Boeing F2B-1s, the unit set its sights on the 1928 races. Tomlinson formed a three man team made up of himself, Lt. W. V. Davis and Lt. A. F. Storrs which made its debut at the dedication of Lindbergh Field at San Diego. At this time the name of the Three Sea Hawks was chosen to identify the group.

Fighting Six, now redesignated Light Bombing Two, was the natural choice to represent the Navy at 1928 races at Los Angeles.

The Three Sea Hawks were easily the match of the Three Musketeers and set a standard for aerobatics that forced subsequent Navy flight teams to perform with their wings linked by 25 ft. lengths of line.

It was at the 1928 races that the first of the tragedies that was to wipe out the Three Musketeers occurred. Lt. J. J. Williams crashed while rolling out of a squirrel cage loop. His place in the team for the rest of the meet was taken by a reserve officer named C. A. Lindbergh. The second member, Lt. W. L. Cornelius, was killed in a mid-air collision over Rockwell Field a short time later. Finally, Lt. I. A. Woodring died in the mid-air explosion of the Detroit-Lockheed XA-9 in 1932.

From the Three Sea Hawks, Tomlinson resigned from the Navy to become an executive of Maddox Air Lines, later merged into what is now TWA. Both Storrs and Davis stayed in the Navy to achieve flag rank, with Vice Adm. Davis now serving as Deputy Commander-in-Chief, U. S. Atlantic Fleet.

WILLIAM A. RILEY
Los Angeles, Calif.

Reversed Key

After reading your magazine, dated Sept. 8, I was able to determine in my own mind the cause of the recent rash of mid-air collisions. The map on p. 44, if you read the key correctly, indicates that we have 28,000 airlines flying coast to coast each week. Obviously 28,000 airlines operating would cause numerous mid-air collisions, and it is a great wonder to me why we have not had more.

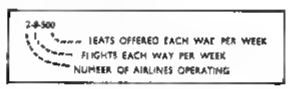
I think a great deal of your magazine, but obviously there was a slipup in the editing or the figures given by the de Havilland Aircraft Co.

I believe the key should read: "The first digit being the number of airlines operating, the second set of digits the flights each way per week, the third set of digits the number of seats offered each way per week." This would mean that we have five airlines flying 473 transcontinental flights each way per week, with a total of 28,000 seats available, rather than as you show it as five seats available, 473 flights per week, and 28,000 airlines operating on the route.

The figures for all the routing segments are wrong, but I chose the transcontinental route as an example because it is obviously more erroneous.

WILLIAM R. DONOHUE
Major, USAF
Montgomery, Ala.

(Major Donohue is correct. Inadvertently, Aviation Week transposed the identification of the figures in the legend.)



SPACE AGE ALCHEMY

New materials, capable of withstanding extremely high temperatures and encompassing properties that meet specific requirements are now being created at Servomechanisms' Research Laboratory. SMI's research has been in the field of solid state physics, wherein the study of basic atomic and molecular properties of matter has resulted in materials that can actually be designed to accomplish specific tasks. The challenging space age will depend heavily upon such techniques.

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The above illustration pictures an experimental hot press, developed by SMI, for basic investigations into these new materials. The press subjects various compounds to 3,600°C and 6,000 PSI in a vacuum or inert gas.

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